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Vol. XXIX **JUNE, 1924** **No. 6**

Page

Editorial Comment 323
The navy. Diesel conversion. Mild steel. The Institution of Naval Architects.
Marine Engineering and Shipping Age, June, 1924.

Transport, the Future of Sea 327
By Archibald Hurd.
Influence of aviation, fuel oil and the motorship. Shipbuilding outlook hopeful.
Marine Engineering and Shipping Age, June, 1924.

Simplified Practice Extended to Pacific Coast 328
Marine Engineering and Shipping Age, June, 1924.

Bonus System, Matson Navigation Company's 329
Matson Navigation Company adopts continuous service bonus system for its employees afloat. Bonus based on length of service and rank, grade or type of employment.
Marine Engineering and Shipping Age, June, 1924.

Diesel Conversion Bill, Senate Passes 331
By Harold F. Lane.
Bill authorizing use of Shipping Board construction loan fund for Diesel conversion goes to conference.
Marine Engineering and Shipping Age, June, 1924.

Passenger Steamship Volendam 333
Passenger accommodations and service of the new 15,450-ton steamships placed in the North Atlantic service by the Holland-America Line. 7 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Sun-Doxford Engines of the Henry Ford II 335
First application of large Diesel engines to a Great Lakes bulk freighter. Details of the engines. 5 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Motorship Dolius 338
By Our Special London Correspondent.
First vessel to be equipped with Still engines. Will be compared with straight Diesel motorship in same service. 2 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Dredge, 26-inch Hydraulic 340
By R. R. Roane.
155-foot dredge of 1,350 gross tons displacement equipped with unusually powerful machinery. 2 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Dredge, Diesel Electric 341
Comparative performance of Diesel electric and steam-driven 15-inch hydraulic dredges shows marked economy of former.
Marine Engineering and Shipping Age, June, 1924.

Battleship Michigan Being Scrapped 342
Marine Engineering and Shipping Age, June, 1924.

Doxford Engine, Three Cylinder 2100 Horsepower .. 343
By Our Special London Correspondent.
New design gives fuel consumption of only 0.35 pound per brake horsepower hour at full load. 1 illustration.
Marine Engineering and Shipping Age, June, 1924.

Threading Machine, Double Spindle 344
Marine Engineering and Shipping Age, June, 1924.

Pneumatic Drill, Ingersoll-Rand Light Weight 344
Marine Engineering and Shipping Age, June, 1924.

Page

Wetted Surface 345
By Henry H. Schulze.
Paper read before Society of Naval Architects and Marine Engineers containing calculations of wetted surface of standardized series of vessels. 13 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Reversing Systems of Large Marine Oil Engines ... 350
By Miss V. Holmes.
Detailed description of both 4 and 2 stroke reversing mechanisms and some consideration of the design of reversing systems. 17 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Oil Burning, Instruction for Students of 356
By Leonard Wernert.
Practical course offered at Todd Free School for marine engineers, firemen and water tenders.
Marine Engineering and Shipping Age, June, 1924.

Tosi Diesel Engine, The 357
By Gian Carlo Ziliotto.
Types built, construction and operation, combined inlet and exhaust valve, injection valve, method of cooling cylinder. 6 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Vessel Equipped with Airship Mooring Mast 360
Marine Engineering and Shipping Age, June, 1924.

Passenger Steamship Columbus, Interior Views of .. 361
Marine Engineering and Shipping Age, June, 1924.

Camber, Sheer and Bevel Nomogram, A Deck 362
By E. V. Telfer, M.Sc.
Method for expressing the mathematical relation for parabolic camber in nomographic form; its application to ship joinery. 1 illustration.
Marine Engineering and Shipping Age, June, 1924.

Water Rates of Marine Reciprocating Engines—II .. 364
By E. A. Stevens, Jr.
Correction for fractional loads. Superheat. Variations. Triple versus quadruple expansion engines. Problems illustrating methods of estimating water rates. 3 illustrations.
Marine Engineering and Shipping Age, June, 1924.

Induction Motors for Shop Use, General Electric ... 368
Marine Engineering and Shipping Age, June, 1924.

Shipping and Shipbuilding Developments, British ... 369
By W. H. Wendon.
London's increased port charges arouse storm of protest. Spanish tax on maritime traffic bitterly opposed. Shipbuilders face financial difficulties. 1 illustration.
Marine Engineering and Shipping Age, June, 1924.

Contrapropeller Fitted to S. S. Norfolk 371
Marine Engineering and Shipping Age, June, 1924.

Riveter, Oilgear Hydraulic 371
Marine Engineering and Shipping Age, June, 1924.

Warship Design 372
By Admiral Sir Doveton Sturdee.
Paper read before Institution of Naval Architects discussing strategical and tactical considerations governing warship design.
Marine Engineering and Shipping Age, June, 1924.

Questions and Answers 375

Letters to the Editors 377

New Books 378

Personal 379

Shipping and Shipbuilding News 380

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The Navy

THE recent report of the admiral in command of the battle fleet has forcibly drawn attention to the Navy and its needs. While we are not quite prepared to take this report entirely at its face value and to accept as a fact the implied deplorable condition of certain vessels, it is most opportune that the naval situation in general should be made a matter of primary interest, both to Congress and to the general public.

It would seem to be the particular duty of this country, in view of its responsibility for the Disarmament Conference, to maintain its fleet actually at the strength fixed for it by that body. Although the President is undoubtedly right in his feeling that there is nothing seriously the matter with the fleet, it is nevertheless, an undoubted fact that the ratio of fleet strength, as regards England and Japan, has not been fully maintained by us and that as regards auxiliary vessels, which are absolutely necessary to maintain the fleet in active service, we are far behind.

The numbers and types of vessels necessary to round out our fleet to an organization of maximum efficiency are undoubtedly fully appreciated by the Navy Department but not so well known to the people in general, and the report from the fleet has at least had the effect of centering attention on this question.

Not only should such additional vessels, of various types, as are required for active fleet operations, be authorized at once but the ships forming the back bone of the battle fleet which are in any sense defective or obsolete should be brought up to the highest standards which modern naval development requires.

Most certainly, the first line vessels should all be oil burners. It is understood that Great Britain is inclined to protest the conversion of our coal burning battleships to oil fuel as contrary to the spirit of the disarmament agreement. This protest can scarcely be taken seriously. There is nothing in the agreement, so far as we are aware, which is prejudicial to maintaining the fleet at the highest possible degree of efficiency and in order that this condition may be arrived at, and the fleet made, from the point of view of operation, as homogeneous as possible, oil fuel on all the ships is essential.

In the matter of increasing the range of the older ships by making such alterations as are necessary to permit of a greater elevation of the guns, there might be more grounds for protest were the proposed alterations of an extensive character. If, in order to increase elevation, it were necessary to raise the trunnions of the guns and change or replace the barbette armor, in fact rebuild the whole structure in the turrets and their immediate neighborhood, the cost would be enormous, and it might be questioned if the disarmament agreement contemplated any such radical change. As a matter of fact, however, the necessary changes are of minor character, the main requirement being to increase the present clearance of the recoil cylinders under the breech of the guns, and this, we are given to understand, can be accomplished without any radical changes or alterations of the turret structure. The barbette and foundations are not affected. In view of these circumstances, it does not appear that any protest rests upon a very substantial basis.

In any event, it seems not only reasonable, but essential, that such ships as we are allowed, by international agreement, to retain should be kept at the highest pitch of effectiveness and efficiency, and, so far as possible, made, at least, the equals in offensive and defensive power of the foreign ships with which they are, by implication at least, compared.

There is another matter, of vital interest to the Navy and the country at large; one which, if ever we are so unfortunate as to become involved in another war, may assume an even greater importance than the physical characteristics of our warships—the supply of sufficient trained personnel and, what is of scarcely less urgency, the supply of auxiliary vessels.

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Congress has been, in the past, by no means backward in authorizing the construction of naval vessels, and at present seems inclined to favorably consider the Navy's immediate needs. Is there no way by which it can be made to see the necessity, for the national defense if for no other reason, of a naval reserve and a merchant fleet? The best ships in the world are of little use without sufficient trained men to handle them and without a background of auxiliaries and supply ships are but a gesture when it comes to actively making war.

No statesman can do a greater service to this country today than to bring home forcibly and convincingly to all of its people the pressing need of an adequate merchant fleet as the most effective insurance against future trouble.

Diesel Conversion

IN our last issue we took occasion to deal at some length with the problem of converting Shipping Board vessels to Diesel drive, as it appears to us that along this line only there lies any reasonable hope for immediate constructive action in aid of the merchant marine.

A substantial start in foreign trade has been made by American vessels. If the country really desires to possess an effective merchant fleet and, in the last analysis, we believe that it does, it is essential that what has already been accomplished should be consolidated and an aspect of permanency replace the haze of doubt which has obscured and impeded the operations of our foreign service ships.

The running of these vessels involves a loss, and while the benefits accruing to the country from their possession and operation cannot, by any means, be measured by the direct cost involved, ordinary business sense demands that this cost be kept as low as efficient service will permit.

The installation of internal combustion engines is, in itself, far from being a complete solution of our shipping problem, but it will, more than any other available means, tend to reduce operating costs and the consequent loss which present conditions appear to make unavoidable. It is a source of gratification to everyone connected with the shipbuilding or shipping activities of the country that the Congress has been brought to this view of the question and has finally passed the amendment to the Shipping Bill of 1920, which authorizes the Board to proceed with the work of conversion.

It is particularly interesting to note that a large amount of preparatory investigation and planning has already been accomplished by the engineers employed by the Shipping Board and that the Board is, consequently, in a position to proceed promptly and intelligently with the work as soon as it has the authority to do so.

The engineering problems involved in the conversion of the Shipping Board vessels do not present, in general, any great difficulty, although the field is practically a new one. In order, however, that the work may be systematically and intelligently carried on, it has been necessary to undertake an enormous amount of preliminary investigation and study.

The cargo carrying ships owned by the Government are all of much the same type but there is a wide range of actual size and capacity, and innumerable minor differences between both the hulls and machinery of the different designs. W the ships selected, as available for conversion, do no clude among their number all of the different designs are comprised in the Board's fleet of cargo vessels tankers, there is still a very broad field to cover. In these vessels range from 3,500 to over 12,000 tons weight capacity, and in power from 1,400 indicated to shaft horsepower. As both reciprocating and turbine chinery is installed, the shafts of vessels of the same and power, as well as their propellers, vary considera diameter. Furthermore, the length of the machinery s varies over a considerable range, and some of the l steam-driven vessels have, relatively, the shortest engin boiler spaces.

Evidently the most difficult task is the selection of efficient propeller for each of the several designs. The delivered by the shaft may be absorbed by a propeller relatively small diameter turning at a high rate or larger propeller running at a less number of revolutions the efficiency of propulsion cannot be expected to be the sa in both cases. For a ship of the type and form under sideration, a large diameter propeller, turning at a moder rate, usually gives the more satisfactory results, partic at sea. But here a limit is at once fixed by the diame of shafts and sizes of screw apertures already in the ves and it seems evident that a compromise will have to effected in the propeller design in order to obtain the l effective power compatible with a reasonable degree of pulsive efficiency.

By constructing curves of propeller efficiency with v ing diameters and powers, cross curves can be derived fr which may be determined the variations in efficiency wheel of a given diameter, at different powers. Thus possible to determine the greatest power which can be nomically absorbed by a given wheel, or whether an incr in power is accompanied by a disproportionate loss of ef ciency—in other words, that the gain in speed would accompanied by an undue expenditure of power. There of course, many more variables entering into the propu problem than those we have mentioned, but by proceedi with them, along similar lines, it has been possible to struct diagrams, whereby the entire practicable field of pe peller and power variation for each class of vessels is clea indicated, and the problem of selecting the best propeller a particular engine in a particular ship and of determin the speed and power to be expected from its use, m simplified.

Although there is a material variation in the space avai able for propelling machinery in the different ships, we be lieve that; in the majority of them, it is possible to inst single acting engines of as great a shaft horsepower as c be generated by the present steam installations, without a extensive alteration of bulkheads. There are, however, a f of the larger ships in which it is impossible to install sin acting engines of sufficient power, without moving the m engine or boiler room bulkheads. Undoubtedly, the be answer to this situation is the installation of a double acti engine. Although no double acting Diesel engine is as y "on the market" in this country, there are several either contemplation or actually in course of construction, and

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ertainly hope to see some engines of this type installed in onverted vessels.

There are many other problems involved which will have o be carefully worked out in order that the proposed con-ersions may, in the greatest possible degree, prove success-ul. The Board's engineers are giving careful study to every ispect of the question and the various ship and engine build-rs are equally interested to get the best possible results. In he last analysis, the satisfactory conversion of the vessels vill depend, more than anything else, upon the efficient co-peration of all the parties concerned. In an operation of uch magnitude, differences of opinion will inevitably occur, ut there is no field of engineering activity in which one arty possesses all the knowledge or has accomplished all he successful results, and we trust that the converted vessels will reflect the combination of the knowledge and experience of all who are concerned in the work of placing them in service.

Mild Steel

OF all the industries which contribute directly to ship-building there is none in which a greater and more consistent progress has been made, during the past thirty years, than the manufacture of structural steel.

The primary reason for the adoption of steel for structural purposes, aside from its greater strength, as compared with wrought iron, was undoubtedly its more uniform quality and the fact that the transverse and longitudinal tensile strength were approximately equal, a property not possessed by wrought iron plates.

As at first produced, mild steel was practically a high grade wrought iron and although its ultimate strength was somewhat higher than that of iron, any considerable increase in this strength, due to increased carbon content, was obtained at the expense of lost ductility, a most important quality, particularly in ship construction.

Steady improvement in the open hearth process and exhaustive study of the chemical and physical properties of its product has been followed by a uniform and consistent raising of the standard of quality of structural steel so that today it is far ahead of what it was in the nineties and so far as uniformity and ductility are concerned leaves little to be desired.

It was early realized, by engineers, that the elastic limit, rather than the ultimate strength, should be taken as the basis of calculations of stress in steel structures, and for this reason the efforts of steel manufacturers have largely been directed to raising the elastic limit without the loss of ductility characteristic of the early mild steel.

As supplied for shipbuilding purposes today, mild steel has the following approximate physical characteristics:

Ultimate strength—60,000 to 70,000 pounds per square inch.

Elastic limit—30,000 to 35,000 pounds per square inch.

Elongation in 8 inches (standard test piece) 20 to 25 percent.

Steel of this quality is produced with such regularity that for the ordinary run of work it may be accepted with entire confidence as to its quality, once the initial specifications are agreed upon.

It was therefore, with something of a shock that we read in a paper recently presented before the Institution of Naval Architects in London the statement that "the elastic limit of ordinary mild steel, as used for ship construction, is, and always has been, on an average about 8 tons per square inch. It sometimes, but infrequently, has a greater value—more often it has values as low as 3 to 4 tons per square inch."

This statement is outside the limits of ordinary engineering experience, so far as our knowledge goes, and seems to call for some investigation. If it is borne out by facts, which we are much inclined to doubt, it is certainly worthy of very serious consideration.

The object of the paper was to describe a new mild steel, having high elastic limit. The use of the word "new" in describing the steel in question appears to be a little misleading, as steels having high elastic limits have been in use for many years, particularly in naval work. This fact was brought out in the discussion of the paper, particular attention being drawn to the Admiralty "H.S.T." steel which has been used in the construction of British submarines for the past 8 or 10 years, and for other purposes over an even longer period. Similar steel is also in use by the United States Navy.

We are not, however, particularly concerned with the question of the priority of manufacture: the elastic limit actually attained is the important matter. A study of the paper and the discussion which followed its reading indicates that the statements about "elastic limit" arose rather from a confusion of terms, or definitions, as generally understood, than from any actual qualities of the steels described.

In addition to ultimate strength, there are several other quantities or points, apparently more or less independent of each other, which may be determined by measurements during a tensile test of mild steel.

A bar of steel, subjected to increasing tension, follows, up to a certain point, what is sometimes known as Hooke's Law, i.e., the stress is proportioned to the strain, and, within this limit, if the load is removed, the bar at once assumes its original length. If a greater load is applied, it is found that the stretch increases at a slightly higher rate, although, if relieved, the bar still will return to its original dimensions so far as can be determined by ordinary measuring instruments. As the load is increased, however, a point is soon reached where permanent stretch, or set, takes place, and an increase in load can only be brought on the bar, by applying it more rapidly than stretching can take place, this continuing up to the point of rupture.

The point where stress and strain cease to be directly proportional is known as the limit of proportionality, the point above which appreciable permanent set takes place, the elastic limit, and the point at which stretching becomes so great that the bar can no longer hold the load, the yield point. The last two points are usually close together and more or less confused. In ordinary commercial specifications for steel, elastic limit and yield point are practically synonymous, or, at least, are generally so considered.

There is a further criterion of the strength of steel, in what is known as the fatigue limit; in other words, the great-

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est stress which may be applied a practically unlimited number of times without causing fracture. This has, by some, been considered to be the same as the elastic limit, but extended experiments during recent years do not seem to indicate any definite relation between the two, beyond the fact that the fatigue limit is less than what is generally accepted as the elastic limit. We believe the several definitions and statements mentioned have been generally accepted by users of structural steel, but it would appear that the writers of the paper have confused limit of proportionality with limit of elasticity, although, even if this is so, their statements seem to be at variance with general engineering experience.

Coming to the case of ships, while the stresses they actually experience are more or less indeterminate, it seems pretty clear that certain members of the structure are occasionally stressed above the elastic limit, without any resulting harm. This is very likely due to a gradual readjustment of the structure, after the load is removed. It was discovered by Baushinger, many years ago, that if a stress above the elastic limit was applied to mild steel and then removed, the result was to raise this limit, and it seems quite probable that a similar action may take place in a ship's structure, all of which points to the value of ductility in steel, this quality making possible the readjustments referred to. A similar action takes place when a plate is cold flanged or bent, the ductility of the material making it possible for the plate to readjust itself and regain its elastic qualities.

The paper would seem to indicate that ordinary ship steel is, in a way, defective, and that it always has been. We are very far from agreeing to this, and while it may be possible, by the use of steel with a very high elastic limit, to somewhat decrease the scantlings of merchant vessels, it would appear that more extended research, and greater evidence of the retention of other essential qualities, when the elastic limit is raised, should be forthcoming before any radical change can be seriously considered.

The Institution of Naval Architects

NOWHERE can the naval architect and the marine engineer nor, indeed, anyone interested in the development of shipbuilding or shipping, find better reading, or more of consuming interest, than in an article, by Mr. R. W. Dana, in the 1924 edition of Brassey's Naval and Shipping Annual.

Under the caption of "The Institution of Naval Architects and Its Work," Mr. Dana, the present secretary of the Institution, has written what, to the naval architect and engineer, amounts, practically, to a history of the development of his profession; for in the work of its many famous members as set forth in the Transactions of The Institution of Naval Architects, is comprised all, or nearly all, of the pioneer work and scientific investigation which have gone to make up the present allied sciences of naval architecture and marine engineering.

While the present organization dates from 1860, there is reason to believe that it practically had its beginning about 70 years earlier. In 1791 there was formed, in London, a society for the investigation and study of the various shipbuilding problems of the day. Known as the "Society for the Improvement of Naval Architecture," this institution had 270 members and for its president the Duke of Clarence, afterwards King William IV. A number of original papers were presented and the historic work of Col. Beaufoy on the resistance of floating bodies was conducted under the auspices of this early society.

The difficulties of providing adequate support, with so small a membership, and the calls of the war, then going on in England, upon the naval officers who formed a large proportion of its members, caused the breaking up of the society in 1799.

While there is no direct connection between the two, there is good reason to believe that the aims and constitution of the earlier society were well known to those who, 70 years later, founded the present institution.

By the middle of the last century, the need of some sort of an organization to promote the scientific study of naval architecture, and to coordinate and systematize its application to the practice of their profession, had become very apparent to British shipbuilders and engineers. Early in 1860 Mr. John Scott Russell, then in the front rank, both as a shipbuilder and engineer, and who, as the designer and builder of the *Great Eastern*, attained world-wide fame, called a meeting at his home at Sydenham, of leading shipbuilders and engineers, with the purpose of forming a society for the study and promotion of the science of naval architecture. Furthermore Mr. Russell himself guaranteed the initial expenses. Of the men present at this first meeting of The Institution of Naval Architects, Scott Russell was perhaps the best known, the world over, but there were others whose names have become household words to the students of naval architecture.

The first president of the Institution was Sir John Pakington (afterwards Lord Hampton) and all through its active life, of over sixty years, to the present time, its various officers and members of council have been men in the forefront of their profession. Barnaby, Woolley, Barnes, Reed, Merrifield, Froude, and later Elgar, Seaton, White, Denny, Thearle and Biles are but a few of these, whose work makes up a large part of the science of shipbuilding, as we know it today.

With an initial membership of 324 in 1860, the Institution in 1900 had 1,500 members, and since, with the exception of the period of the world war, has increased rapidly, year by year, to its present membership of nearly 3,000. The membership is international in character.

From its earliest years, the Institution has devoted much attention to the education of naval architects, and to a paper read by Scott Russell, in 1863, was directly due the reopening of the Royal School of Naval Architecture at Greenwich. Not only has the Institution, by founding scholarships in various schools, encouraged the study of naval architecture and engineering, but by research or post graduate scholarships is providing for advanced work of exceptional value along many lines of investigation.

In its 63 years, the Institution has not only had a major part in the development of shipbuilding and engineering but, by its contributions to these basic industries, has been an important factor in the building up to its present strength of the British Empire.

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The Future of Sea Transport*

Influence of Aviation, Fuel Oil and the Motorship—Shipbuilding Outlook Hopeful

By Archibald Hurd

It is open to doubt whether at any previous period the conditions of shipbuilding and marine engineering and ship operating have been as complicated and confusing as they are at this moment. The war emphasized the importance of merchant ships, as it was revealed that, however large and efficient a navy might be, it would stand defeated in an oceanic contest unless it were supported by vessels capable of carrying fuel, stores and other necessaries of war. Events suggested that in pursuing an oceanic policy it was not sufficient to possess a navy of fighting vessels, but that those fighting vessels required constant support from ships built for the purposes of peace.

The vast destruction of wealth as the war lengthened out—suggested to many foreign observers that peace would be followed by a well-sustained trade boom, when stocks of goods in all parts of the world would be replenished, and that insufficiency of tonnage to carry the trade would lead to high freights and consequent high profits.

Effect of the War on Shipbuilding

In these circumstances the great shipbuilding movement developed. Our own experience in these islands was exceptional, for, though shipbuilding and engineering facilities were increased, the increase was not on the scale witnessed in the United States and elsewhere. The average annual output of merchant shipping in British yards for the twenty years prior to the outbreak of the war was 1,364,000 tons; in the four years 1918-1921 it reached 1,640,000 tons, touching high-water mark in 1920, when just over 2,000,000 tons were put afloat—about the same as in the year preceding the outbreak of the war.

When hostilities closed we had in hand, in addition to merchant tonnage, a considerable number of war vessels, which employed many more thousands of skilled artisans than had ever before been engaged on warship production; consequently the activity on merchant and war tonnage was greater than at any previous period. In these circumstances our shipbuilding resources assumed exaggerated proportions in comparison with the probable demand for merchant ships in future years and the restricted orders which it was probable that the Admiralty, in the new conditions created at Washington, would be giving out.

It is, perhaps, hardly realized how greatly the Washington Treaty served the interests of the taxpayers generally to the injury of all concerned in the production of naval armaments, one of our most important industries.

It was in these circumstances that the slump in shipbuilding and marine engineering occurred immediately the large amount of tonnage which had been lost during the war had been made good. On the one hand, practically no warship orders were given out, and, on the other, there was little or no demand for merchant tonnage. Fortunately for British firms concerned with shipbuilding and marine engineering this country contributed hardly at all to the access of carrying power, since the post-war merchant fleet under the Red Ensign was at the end of June last only 200,000 gross tons larger than in June, 1914—a negligible increase.

We have built to our requirements and not to over-vaunting ambitions, and the outlook for the twin industries of shipbuilding and engineering in this country, it may be suggested, is therefore brighter than in any other.

German Merchant Marine Being Rebuilt

It might form an interesting subject for discussion whether it would not have been better to have permitted Germany to retain her sea-going vessels, most of them fairly old, instead of selling them to the Reparations Account. Whatever may be thought of the surrender policy, it is incontrovertible that the Germans were encouraged thereby to devote themselves with great determination to the rebuilding of their merchant fleet on a higher standard of operating efficiency. With the tonnage which has been purchased abroad, the German mercantile marine has already obtained vessels of not far short of 3,000,000 tons, consisting, in the main, of newly constructed and highly efficient ships. Already the German flag is to be seen in all the seas and oceans and in every port.

It is apparent that under the most favorable circumstances we can never find employment for all the workers now in the allied industries in view of the great expansion of facilities which took place under the pressure of the submarine campaign. That involves a policy of scrapping, and not, unhappily, of plant only. What is to happen eventually to the surplus labor which was drawn into these industries immediately after the conclusion of the war must be a matter of grave concern. In this respect the Americans could show us the way, as other industries there have apparently absorbed all the post-war surplus of the shipyards—a matter of many thousand men. Our trade union system in this respect is not, however, very helpful. Labor in this country is no longer fluid, and we have excess in one trade and shortage in another without the possibility of such adjustments as can be made in the United States and were usual in this country in the past.

Influence of Aviation

It may be argued that the conquest of the air by man, in its reaction on shipbuilding, must not be ignored in any attempt to forecast the outlook of shipbuilding and marine engineering. During the war, air-power developed with extraordinary rapidity, and we formed a high estimate of the contribution which it made to victory. Most of us carried the impression of the value of air-power which we had formed in war conditions into the era of peace. Successive Governments, ignoring natural and economic laws and under the pressure of public opinion, have endeavored for the past five years to galvanize civil aviation into life.

In all discussions on air-power, military and civil, there has been a tendency to forget the physical basis upon which our fighting navy and our commercial navy have rested—the one complementary to the other. First and last, it is not so much mobility as weight-carrying power which justifies sea-power. That emphasis on weight-carrying power applies to the ship of war as well as to the ship of commerce. The burden of both, whether armaments or commerce, is cast on the sea, and man's efforts have been solely directed to moving the weight of cargo of armaments or goods through the water with the least expenditure of motive power, and therefore of money. The ship of war has always been complementary to the ship of commerce, since the qualities of both ceased to be combined in one hull.

*From a paper read at the spring meetings of the sixty-fifth session of the Institution of Naval Architects, London, April 10, 1924.

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For many reasons, it seems probable that, even with the aid of Government subsidies, civil aviation will develop slowly to the limit of our present vision, since there is no possibility of as close relationship between air-power for war purposes and air-power for commercial purposes as there is between the fighting ship and the ship of commerce, the one helping to sustain the other. International trade under steam is not carried at a higher average rate than 10 knots, and there is no reason to anticipate that merchants generally will desire, and will pay the price for, greater speed in carriage in future, even if safety and reliability in the air be proved to be as good as by sea, and insurance of carriage by air be no greater than by sea.

On the other hand, air-power is probably destined to prove of inestimable value in contracting the vast time-distances of the British Empire, and will be employed more and more in carrying a restricted number of passengers-in-a-hurry who have deep pockets, and in conveying light cargoes such as mails and goods of small bulk and high value, the delivery of which it is desired to expedite. That development will not injure mercantile shipping.

The progress which is made by civil aviation, inevitably slow and restricted, will depend upon a scale of subsidies such as have never been provided in any country in the past for the development of commercial sea-power.

The Importance of Oil Fuel

When reference is made to the airship for travel over long distances, and the aeroplane for shorter distances, we do well not to ignore the influence which oil, in association with the internal-combustion engine, is going to exercise in rendering sea transport cheaper and more efficient. One pound of coal will carry a ton of goods twenty-five miles by sea, but one pound of oil will carry that ton of goods three times as far. The motorship at present involves a higher initial cost than the steamer, but the motors occupy less space than the ordinary steam-engine with its boilers, and requires less attention. The result is that the motorship achieves great direct economies in operation, having larger space available for passengers or cargo, and requiring a smaller crew, apart from the saving in fuel per sea mile. But this is not all, as the experience of the Royal Navy during the war must suggest to all who are familiar with the conditions in which our ships of war were then employed. If it had not been for Lord Fisher's vision, which led to the Navy adopting oil in the place of coal early in this century, it is doubtful whether the British Fleet, in spite of its preponderance over the German Navy, could have kept the sea in sufficient strength during the long ordeal in the face of an enemy who could issue forth from his bases at his selected moment and exert his maximum fighting power.

In the case of the Navy, oil fuel added greatly to the power which could be exerted at sea at the average moment. Its influence on the British mercantile marine will be similar. Ships will be in port for shorter periods, and consequently will be able to carry more cargoes and earn more profits. These considerations, it may be suggested, are to some extent balanced by the unpleasant fact that, while we possess enormous coal measures still waiting exploitation, we have in this country no oil supplies of much importance, but are dependent upon the importation of oversea supplies, most of which are not even under British control. But, in fact, we have oil in our coalfields. Distillation would give us smokeless fuel for use in our domestic grates, and oil, heavy and light, for manifold purposes, tar for our roads, and dyes for our clothes, besides leading to an improvement in the health of the community, a lengthening of the life of all public and other buildings, a reduction of laundry bills, and an enormous saving of woman's labor in palace, house and cottage. Judged broadly, distillation would already handsomely even now. The time will come when [illegible] will demand the boon of smokeless cities and towns, and the mercantile marine will get British oil.

The British shipowner, in spite of the economies effected by the motorship, and the evidence that the motorship could earn profits in moving ocean-borne commerce where the cargo-carrying steamer incurs only losses, hesitated for a time to turn from the steam-engine to the motor. This hesitation was probably due, in large measure, to doubt as to the rate of depreciation of the motorship as compared with the steamer. As an observer who studies such developments would suggest that, whatever disadvantages in these respects the motorship may have had over the steamer, the time is not far distant when it will be established that the motorship in most conditions of sea transport is, first and last, the most economical cargo-carrier viewed from every standpoint.

It may be suggested that in the development of the motorship lies the hope of the shipbuilding and marine industries of this country. The fact that we already possess a huge volume of modern steam tonnage, half the ships under the British ensign having been built in the past ten years, will hinder that development, but there is happily no such surplus of ships above our normal requirements as a good many other countries possess, to their increasing embarrassment in the future.

Shipbuilding Outlook Hopeful

In view of all these circumstances—first, the absence of a surplus of tonnage in the British mercantile marine above our normal requirements; secondly, the limited sphere of commercial usefulness of the airship and the aeroplane; and thirdly, the advent of the motorship—I would suggest that the outlook for the shipbuilding and marine engineering industries in this country is full of promise. Competition will no doubt be fierce, both as it affects the shipbuilder and the marine engineer, and as it affects also the shipowner. The necessity must, no doubt, be faced of scrapping the less efficient shipyard plant, bringing the facilities back to something less than pre-war level, and scrapping also the less efficient workers, who came into the industry after the demobilization of the war-workers. But these twin processes will be governed by the law of the survival of the fittest; and for the rest the prospects of the industries rest in establishing cordial relations between masters and men in order that combined effort may be made to increase the rate of production and reduce costs, for only by these means can foreign orders be obtained.

Surveying the whole field, therefore, the outlook for sea transport, in its reaction upon the allied marine industries of this country, is hopeful. But competition, fierce and well sustained, will have to be faced with all the initiative, courage and acquired skill which have been exhibited in the past, and at a time when crowded audiences in London are being told every night that it pays to advertise, the gentle art of publicity should not be ignored.

Simplified Practice Extended to Shipping Interests of Pacific Coast

EFFORTS of the American Marine Standards Committee to improve and standardize practices in construction, equipment and mechanical operation, to bring the American merchant marine to a high degree of efficiency will be extended to the shipping interests of the Pacific Coast, according to an announcement by the Division of Simplified Practice, Department of Commerce, which is cooperating in the problems.

Colonel E. A. Simmons, of New York City, chairman of the executive board of the committee, who is visiting Pacific Coast cities, will hold conferences with shipping leaders in those cities looking to the establishment of a Pacific Coast panel of the American Marine Standards Committee.

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Matson Navigation Company Adopts Continuous Service Bonus System for Its Employees Afloat

Year's Trial Shows That About One-Third of the Men Are Participating—Bonus Based on Length of Service and Rank, Grade or Type of Employment

THE Matson Navigation Company, of San Francisco, Calif., was founded many years ago by the late Captain William Matson on a small but substantial basis. Today, through following its founder's principles of "live and let live," the company has developed into one of the leading steamship organizations on the Pacific Coast, maintaining a highly efficient passenger and freight service to and from the Hawaiian Islands, with San Francisco its home port.

During these years of development there has always been the personal contact between executives and office force, which creates the feeling of interest in the company's welfare, and such relations result in promotions. This spirit of cooperation has continually spread throughout the organization and has no doubt aided in the company's success. In the last two or three years the company's officials have been giving thought to the eight hundred employees afloat, feeling that, in the years of development personal contact in this branch of the service had been lost. Considerable thought, therefore, has been given to various plans to show the "men afloat" that the company recognizes efficiency and service as well as a man's interest in his work and desires to reward such qualities.

Cooperation

IN all big business of today it is very noticeable that the spirit of cooperation is being developed to a higher degree, the result, no doubt, of a better understanding between employer and employee. The American boy always has the chance of advancement, but his rise in any particular field of endeavor depends on opportunity, ability and his aptitude of purpose; it, therefore, is not uncommon for the newsboy of today to be the publisher of tomorrow or the locomotive engineer of today to become the railroad president of tomorrow. It is such opportunity and developments that are bringing about this closer harmony between employee and employer, and which should be found in the shipping industry.

The prize plan or pension was considered but discarded for the reason that its meaning is misleading, and it cannot be applied with general satisfaction to all concerned. A prize of monetary consideration, for example, is offered to the vessel showing the highest efficiency or with the best conducted departments, but who is qualified at the end of each year to decide the winner? Such schemes cannot be worked out in practice as conditions, types of vessels, trades, nature of cargoes handled, etc., make an unbiased award impossible. The promise of a pension means nothing, as the future for all of us is so uncertain, the question would be, how many would live to a pensionable age?

Last year Captain C. W. Saunders, operating manager, worked out a continuous service bonus plan, which was accepted by the company's executives, and put in force at the beginning of 1923. Although it has been in effect one year, the company's records show that about 33½ percent of the men participated, indicating its future success.

This bonus, in principle, is to give every employee afloat a chance to earn enough by his own efforts to provide something against the day which is coming to all of us—the day when we can no longer work. Every man is entitled to the chance without charity, but if he prefers waste to thrift, that is his own affair. It, however, imposes no obligation on the company to retain in its employ any unsatisfactory employee, nor does it impose any obligation on an employee to remain in the service if he chooses to quit.

What the Continuous Service Bonus Is

This service bonus is based upon the rank, grade or type of employment, and not upon past, present or future wages, which fluctuate. It is therefore in addition to the regular wages and paid at the end of each year based on continuous service. No employee is entitled to such bonus who is not in the employ of the company at the end of the year for which it is paid, and who has not been in the continuous employ of the company during the whole year, except in the case of new employees entering the employ of the company during the year. Such new employees, who enter the company's employ prior to July 1 of the year of their first employment, will be entitled to a prorata portion for the actual time served up to the end of the year, at the bonus rate which would apply to the first year's service. In the event of a new employee coming into the service after July 1 no bonus will be paid until the end of the next following year, at which time he will be paid a bonus for the entire period of service to date.

Continuous service is required as a condition for the payment of any bonus whatsoever, unless such continuous service is prevented by sickness or by leave of absence granted by an authorized representative of the company. But if any employee's continuous service is broken for reasons other than the above and he later returns to the company, he comes in on the basis of a new employee.

How the Bonus Grows

The bonus is being paid on a schedule ranging from $12 to $60 per year, based on grades of employment for the first year, and it will grow year by year according to the number of years' service and grades of employment. The rate of any employee's bonus is not calculated upon more than ten years' service, but such rate for bonus does not necessarily become fixed at the end of ten years, if he continues in the company's employ and advances his position. Under such circumstances the service bonus may be increased so that it represents the bonus rate applying to the position held by the employee during his last ten years of service. This can be best illustrated by the following example:

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Assuming an employee to start in the employ of the company January 1, 1923, as a deck boy or ordinary seaman, and assuming that this employee during the next ten years of continuous service works up to the position of second officer; the schedule of bonus payments in such a case would be as follows:

TYPICAL SCHEDULE OF BONUS PAYMENTS

	Bonus at end of each year
1923—Deck Boy or Ordinary Seaman	$12.00
(Promoted to A. B. Seaman January 1, 1924.)	
1924—A. B. Seaman, $24.00 plus $12.00	36.00
1925—A. B. Seaman, $24.00 plus $36.00	60.00
(Promoted to Quartermaster January 1, 1926.)	
1926—Quartermaster, $30.00 plus $60.00	90.00
1927—Quartermaster, $30.00 plus $90.00	120.00
(Promoted to Fourth Officer January 1, 1928.)	
1928—Fourth Officer, $36.00 plus $120.00	156.00
(Promoted to Third Officer January 1, 1929.)	
1929—Third Officer, $42.00 plus $156.00	198.00
1930—Third Officer, $42.00 plus $198.00	240.00
(Promoted to Second Officer January 1, 1931.)	
1931—Second Officer, $48.00 plus $240.00	288.00
1932—Second Officer, $48.00 plus $288.00	336.00

As this man continues to advance in rank, he attains his maximum bonus in the following manner:

(Promoted to Chief Officer January 1, 1933.)

1933—Chief Officer, $54.00 less $12.00 (first year bonus, see 1923) or $42.00 plus $336.00	378.00
1934—Chief Officer, $54.00 less $24.00 (second year bonus, see 1924) or $30.00 plus $378.00	408.00
1935—Chief Officer, $54.00 less $24.00 (third year bonus, see 1925) or $30.00 plus $408.00	[illegible]
1936—Chief Officer, $54.00 less $30.00 (fourth year bonus, see 1926) or $24.00 plus $438.00	[illegible]
1937—Master, $60.00 less $30.00 (fifth year bonus) or $30.00 plus $462.00	[illegible]
1938—Master, $60.00 less $36.00 (sixth year bonus) or $24.00 plus $492.00	[illegible]
1939—Master, $60.00 less $42.00 (seventh year bonus) or $18.00 plus $516.00	[illegible]
1940—Master, $60.00 less $42.00 (eighth year bonus) or $18.00 plus $534.00	[illegible]
1941—Master, $60.00 less $48.00 (ninth year bonus) or $12.00 plus $552.00	[illegible]
1942—Master, $60.00 less $48.00 (tenth year bonus) or $12.00 plus $564.00	[illegible]
1943—Master, $60.00 less $54.00 (eleventh year bonus) or $6.00 plus $576.00	[illegible]
1944—Master, $60.00 less $54.00 (twelfth year bonus) or $6.00 plus $582.00	[illegible]
1945—Master, $60.00 less $54.00 (thirteenth year bonus) or $6.00 plus $588.00	[illegible]
1946—Master, $60.00 less $54.00 (fourteenth year bonus) or $6.00 plus $594.00	[illegible]

This deck boy has through his ambition and aptitude attained a master's berth in fifteen years, during which time he has added a total of $3,714 to his regular wages. For each year's service thereafter as master he will receive $ per year, which is good insurance against old age. It encourages thrift, as one of their older masters said: "I felt if it did not belong to me, so I put it away."

Similar promotions in the other departments are at times possible, as is shown in the following table:

TABLE SHOWING IN DOLLARS AMOUNT OF BONUS RECEIVED FOR CONSECUTIVE YEARS OF SERVICE

YEARS IN SERVICE	1	2	3	4	5	6	7	8	9	10 and up
Master	60	120	180	240	300	360	420	480	540	600
Chief Officer	54	108	162	216	270	324	378	432	486	540
Second Officer	48	96	144	192	240	288	336	384	432	480
Third Officer	42	84	126	168	210	252	294	336	378	420
Fourth Officer	36	72	108	144	180	216	252	288	324	360
Carpenter	30	60	90	120	150	180	210	240	270	300
Boatswain	30	60	90	120	150	180	210	240	270	300
Quartermaster	30	60	90	120	150	180	210	240	270	300
Radio Operator	30	60	90	120	150	180	210	240	270	300
A. B. Seamen	24	48	72	96	120	144	168	192	216	240
Ordinary Seamen	12	24	36	48	60	72	84	96	108	120
Deck Boy	12	24	36	48	60	72	84	96	108	120
Chief Engineer	54	108	162	216	270	324	378	432	486	540
1st Assistant Engineer	48	96	144	192	240	288	336	384	432	480
2nd Assistant Engineer	42	84	126	168	210	252	294	336	378	420
3rd Assistant Engineer	36	72	108	144	180	216	252	288	324	360
4th Assistant Engineer	30	60	90	120	150	180	210	240	270	300
Junior Engineers	30	60	90	120	150	180	210	240	270	300
Electrician	30	60	90	120	150	180	210	240	270	300
Plumber	30	60	90	120	150	180	210	240	270	300
Deck Engineer	30	60	90	120	150	180	210	240	270	300
Storekeeper	24	48	72	96	120	144	168	192	216	240
Watertenders	24	48	72	96	120	144	168	192	216	240
Oilers	24	48	72	96	120	144	168	192	216	240
Firemen	24	48	72	96	120	144	168	192	216	240
Wipers	24	48	72	96	120	144	168	192	216	240
Purser	48	96	144	192	240	288	336	384	432	480
Doctor	36	72	108	144	180	216	252	288	324	360
Freight Clerk	36	72	108	144	180	216	252	288	324	360
Assistant Freight Clerk	30	60	90	120	150	180	210	240	270	300
Chief Steward	48	96	144	192	240	280	336	383	432	480
Second Steward	36	72	108	144	180	216	252	288	324	360
Chief Cook	36	72	108	144	180	216	252	288	324	360
Chief Baker	36	72	108	144	180	216	252	288	324	360
Chief Butcher	36	72	108	144	180	216	252	288	324	360
Third Steward	30	60	90	120	150	180	210	240	270	300
Second Cook	30	60	90	120	150	180	210	240	270	300
Second Baker	30	60	90	120	150	180	210	240	270	300
Second Butcher	30	60	90	120	150	180	210	240	270	300
Bartender	24	48	72	96	120	144	168	192	216	240
Stewardess	24	48	72	96	120	144	168	192	216	240
Printer	24	48	72	96	120	144	168	192	216	240
Third Cook	24	48	72	96	120	144	168	192	216	240
Fourth Cook	24	48	72	96	120	144	168	192	216	240
Fifth Cook	24	48	72	96	120	144	168	192	216	240
Third Baker	24	48	72	96	120	144	168	192	216	240
First Pantryman	24	48	72	96	120	144	168	192	216	240

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TABLE SHOWING IN DOLLARS AMOUNT RECEIVED FOR CONSECUTIVE YEARS OF SERVICE (CONTINUED)

YEARS IN SERVICE	1	2	3	4	5	6	7	8	9	10 and up
Messman	18	36	54	72	90	108	126	144	162	180
Pantryman	18	36	54	72	90	108	126	144	162	180
Scullerymen	18	36	54	72	90	108	126	144	162	180
Deck Stewards	12	24	36	48	60	72	84	96	108	120
Watchman	12	24	36	48	60	72	84	96	108	120
Linenman	12	24	36	48	60	72	84	96	108	120
Janitors	12	24	36	48	60	72	84	96	108	120
Saloonman	12	24	36	48	60	72	84	96	108	120
Waiters	12	24	36	48	60	72	84	96	108	120
Bellboys	12	24	36	48	60	72	84	96	108	120

Promotion is open to every man in the company's employ who deserves it, and who keeps himself fit and qualified to take the next job ahead of the one that he holds. However, here are certain unlicensed positions on board of all vessels where the opportunities of promotion are rare, such as carpenters, radio operators, cooks, bakers, butchers, etc. These men, by specializing in their trades or callings, become proficient and valuable there, and such service is recognized and rewarded as is shown by the following example:

A carpenter, who enters the company's employ, say, on January 1, 1923, and remains continuously for a period of ten years, would receive a bonus as follows:

End of first year	$30.00
End of second year	60.00
End of third year	90.00

and so on until the tenth year when he would receive a bonus of $300 and from that time on, providing he remains with the company, he would receive $300 for each year's continuous service, in addition to his regular wages.

Captain Saunders has faith in his bonus plan, as he understands the sailors' viewpoint, and believes it is "put up" to them as one seafaring man would talk to another and in turn creates a personal interest in their vessels as one would take in his own house. There is, however, in every walk of life the man who looks only to the present. This type will not be attracted by any cooperative plan, nor will he even be of value to himself or his employer. It is for these reasons that the Matson bonus plan was inaugurated, as it puts the matter strictly up to the men.

Senate Passes Diesel Conversion Amendment to Shipping Bill

By Harold F. Lane

WASHINGTON, D. C.

THE bill to amend sections 11 and 12 of the Merchant Marine Act of 1920 so that part of the funds set aside by the Shipping Board as a construction loan fund may be used for converting vessels for operation with Diesel engines, up to the amount of $25,000,000, and for loans for that purpose, was passed by the Senate on May 22, but with some slight verbal changes from the form in which it was passed by the House on April 2 which necessitated sending the bill to conference. It was expected that the bill would be reported out by the conferees within a very short time and that the conference report would then be adopted both by the House and the Senate without delay and that the bill would receive the President's signature without question.

There is a balance available in the construction loan fund of about $66,000,000 but under the old law this could be used only for the construction of new ships and the plan to use part of the sum for Dieselization was adopted for the purpose of promoting the sale of some of the vessels which the Shipping Board has thus far been unable to sell and also to promote the building up of the Diesel engine industry in this country.

Although no definite plans have been announced or decided on pending the final passage of the bill tentative plans have been worked out in the Shipping Board, subject to the approval of the board, for taking advantage of the new law as soon as possible by letting contracts for the conversion of possibly a dozen of its ships that are now laid up in need of engine replacement. If this plan is approved, it would involve an expenditure of some $5,000,000 or $6,000,000 and it is proposed to place the contracts with engine builders and shipyards in such a way as to promote some development work and gain experience which may lead to progress in the art. The general idea is to spread the expenditure of the $25,000,000 over four or five years.

APPLICATION OF SECTION 28 POSTPONED

On May 8, the Shipping Board issued the following statement, withdrawing its previous certification to the Interstate Commerce Commission calling for the enforcement of Section 28:

The Shipping Board today, by a vote of 4 to 3, Commissioners Benson, Haney and Thompson voting in the negative, adopted a resolution withdrawing its limited certification to the Interstate Commerce Commission regarding adequacy of American flag tonnage to certain foreign trade ranges upon which the Interstate Commerce Commission has ordered the suspension of Section 28 to be lifted as of June 20, 1924.

As is well known, the Shipping Board, a long time prior to making its certification, held hearings throughout the country for the purpose of giving those interested an opportunity to present their views regarding adequacy of tonnage to meet particular needs and regarding the enforcement of the Section generally.

After careful consideration, in the light of the evidence before it, the Shipping Board made its certification to the Interstate Commerce Commission, upon which the Commission acted. Immediately a storm of protest against application of the section arose from ports, commercial organizations and shippers all over the United States, resulting in hearings by the House Committee on Merchant Marine and Fisheries. After carefully considering the evidence presented to it the House Committee, by a vote of 14 to 2, reported favorably a bill to postpone the effective date of the enforcement of Section 28 until May 1, 1925.

Under all of the circumstances, therefore, the Board has withdrawn its certification from the Interstate Commerce Commission. It is the primary desire of the Shipping Board to secure the cooperation of shippers and railroads in support of the American merchant marine and in giving this concession it expects that shippers will in turn do their part in the building up of American shipping.

It is the intention of the Board, in conjunction with other departments of the Government interested, and with the commercial interests affected, to continue the intensive study of the subject with the purpose of making Section 28 effective within a reasonable time. It is expected that by the beginning of the new year the situation will have so clarified itself that Section 28 may then go into effect.

PLUMMER REAPPOINTED

The Senate on May 23 confirmed the President's reappointment of Edward C. Plummer as a commissioner of the United States Shipping Board for a six-year term of office.

Marine circles are keenly interested in the passage by the House of Representatives of the bill for the construction of eight scout cruisers, six river gunboats and extensive improvements to six battleships, at an estimated cost of $111,000,000.

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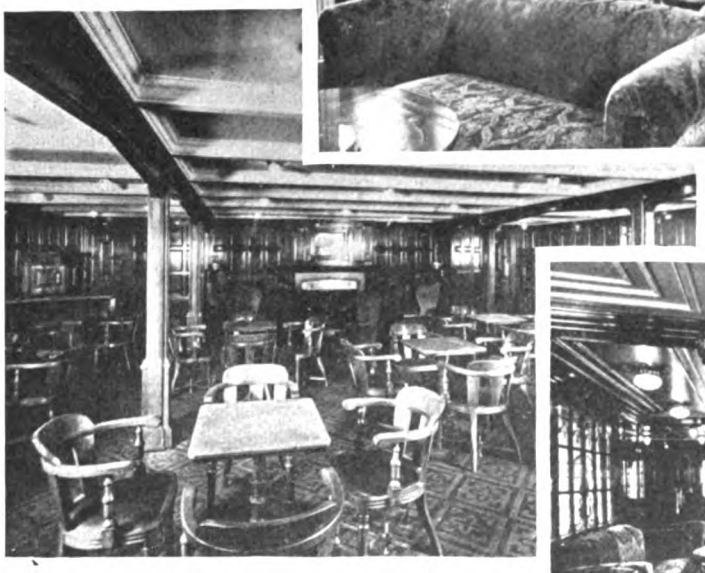
Right—Second Cabin Dining Room

Below—Corner of First Class Dining Saloon

Right—First Class Social Hall and Ballroom



Above—Second Class Smoking Room

Right—First Class Library

Interior Views of the Holland-America Liner Volendam

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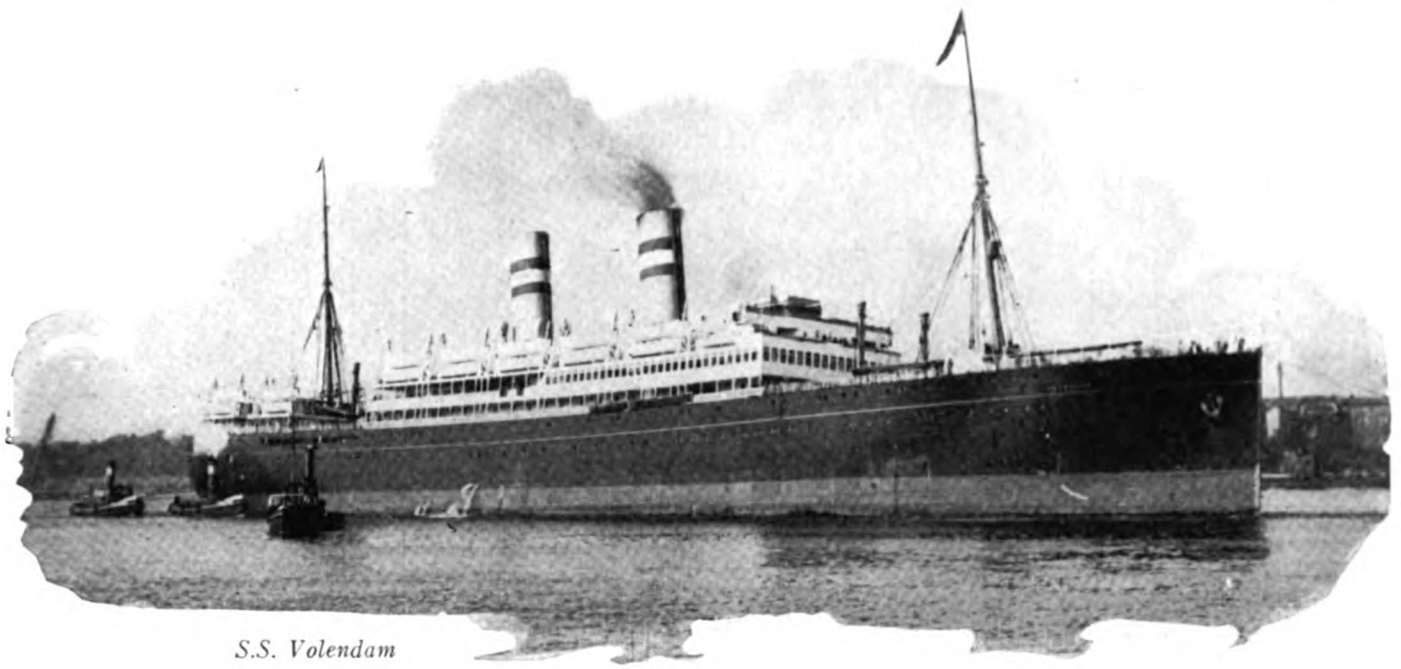

S.S. Volendam

New Passenger Liners Placed in Atlantic Service

Passenger Accommodations and Service of the 15,450-Ton Steamships Volendam and Veendam of the Holland-America Line

THE sister ships *Volendam* and *Veendam* of the Holland-America Line have recently been placed in the weekly New York-Boulogne-sur-Mer service maintained by this company with the steamships *Rotterdam, Amsterdam, Noordam* and *Ryndam.* These ships were designed by the company exclusively for its own service, so that special features, unique on its ships, have been incorporated. The result is that these steamers possess the essentials necessary to inspire passengers with that sense of comfort and refinement for which the vessels of this line are noted.

These two ships are somewhat smaller in length of hull than the *Rotterdam* and *New Amsterdam,* but their relatively greater width permits spacious accommodations and public halls.

In the first cabin, most of the rooms have bedsteads, hot and cold running water, many are provided with private baths, large ports or windows, wardrobes and many other conveniences which add to the traveler's sense of comfort.

On the *A* deck a single row of rooms on the starboard and another row on the port side, nearly amidships, have been provided. Because of this arrangement practically every room is an outside one. Each room has two beds, while every other room has a pullman berth to accommodate a third passenger, if desired.

The arrangement of rooms on *B* deck is a combination of rooms with bath, as on the *Rotterdam,* and tandem rooms, as on the *New Amsterdam.* On this deck there are thirty-two rooms, each having connection with a private bath and toilet room.

Stairway

The dining saloon, located on *C* deck has a seating capacity for 242 guests. The walls are finished in mahogany, the ceiling in cream and gold with a large open well in the center. The promenade deck, which is above *A* deck, and below the sun deck, is partly closed as a protection against wind, spray or wet weather and one of its features is the generous amount of unobstructed space for promenading. On this deck also are located the library, social hall, ball room and smoke room, all of exceptionally fine design and proportion.

Second Cabin Accommodations

Of the second cabin accommodations, the smoke room is located on *A* deck, an attractive lounge room for ladies on *B* deck while the dining saloon is situated on the *C* deck. All of the lounge and social rooms of the second cabin are planned for the greatest comfort of those traveling and are well decorated, spacious and airy.

The second cabin staterooms are located on decks *B, C* and *D* and are arranged to accommodate two, three or four passengers each. Everywhere in the second, as well as in the first cabin, problems of ventilation, sanitation, bathing and toilet facilities, safety appliances and modern conveniences by means of electrical devices have been dealt with in a thorough-going manner.:

The vessels are 576 feet long, 67 feet beam and 45 feet depth with a displacement of 25,620 tons.

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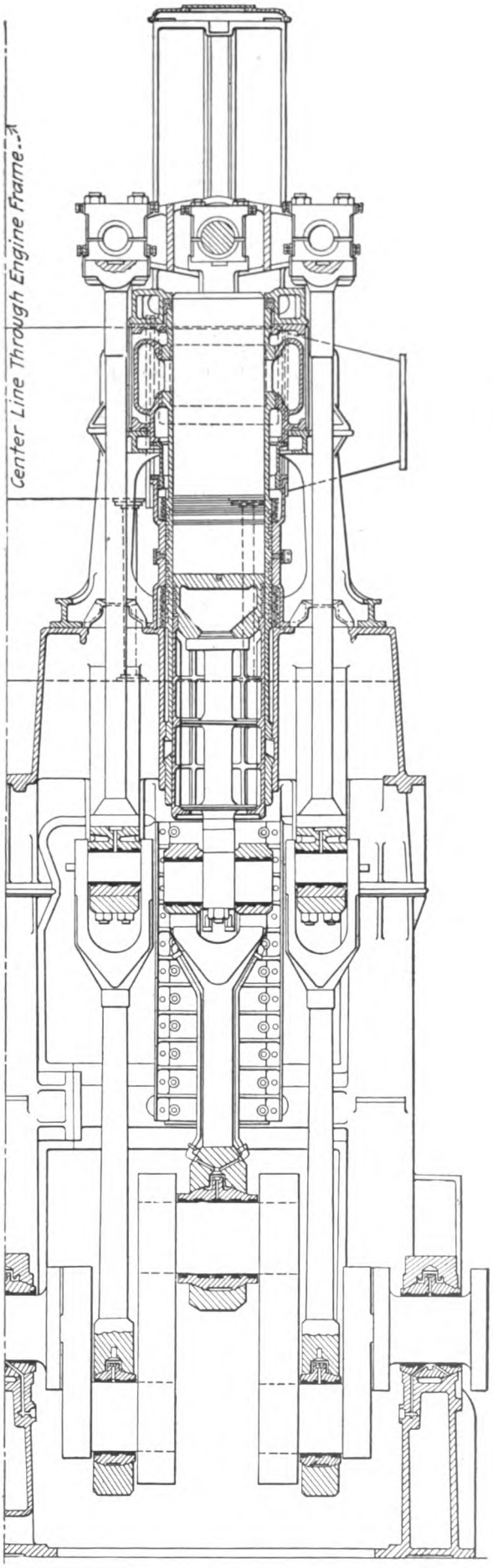

Fig. 1.—Longitudinal Section of Forward Cylinder

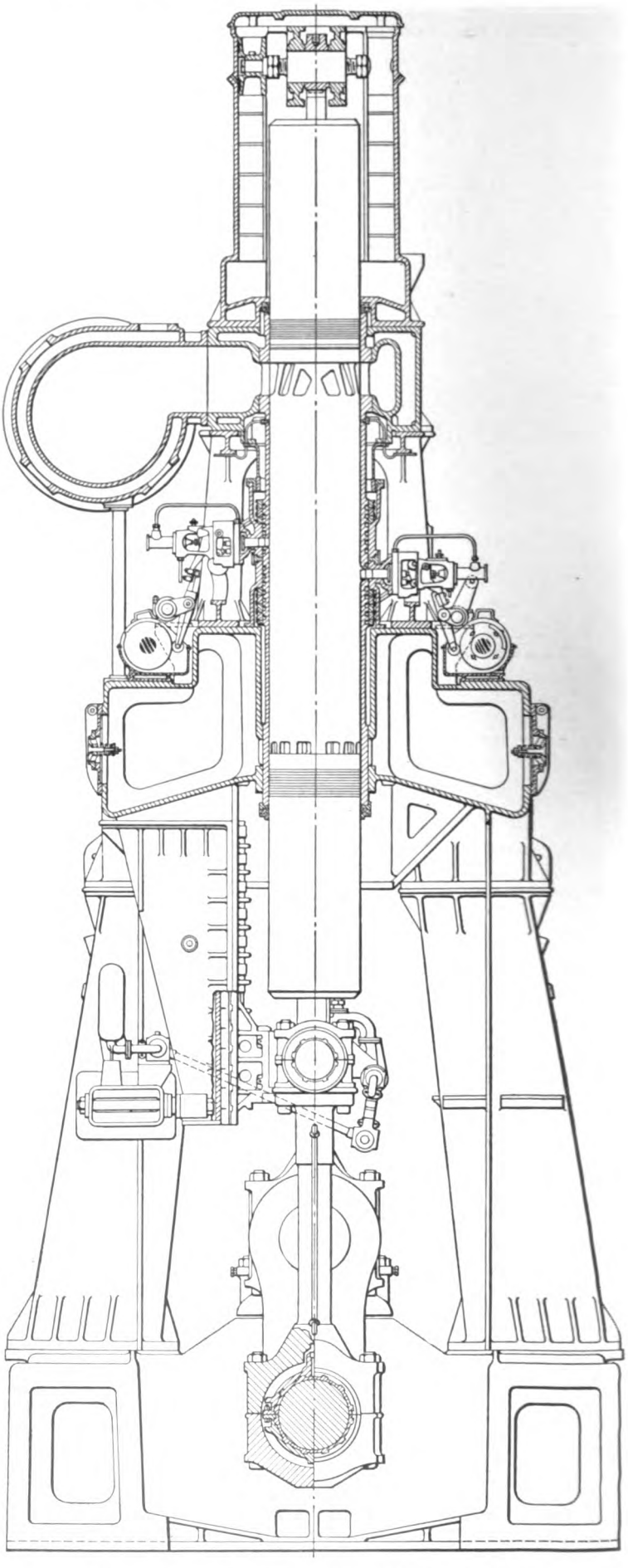

Fig. 2.—Transverse Section of Forward Cylinder

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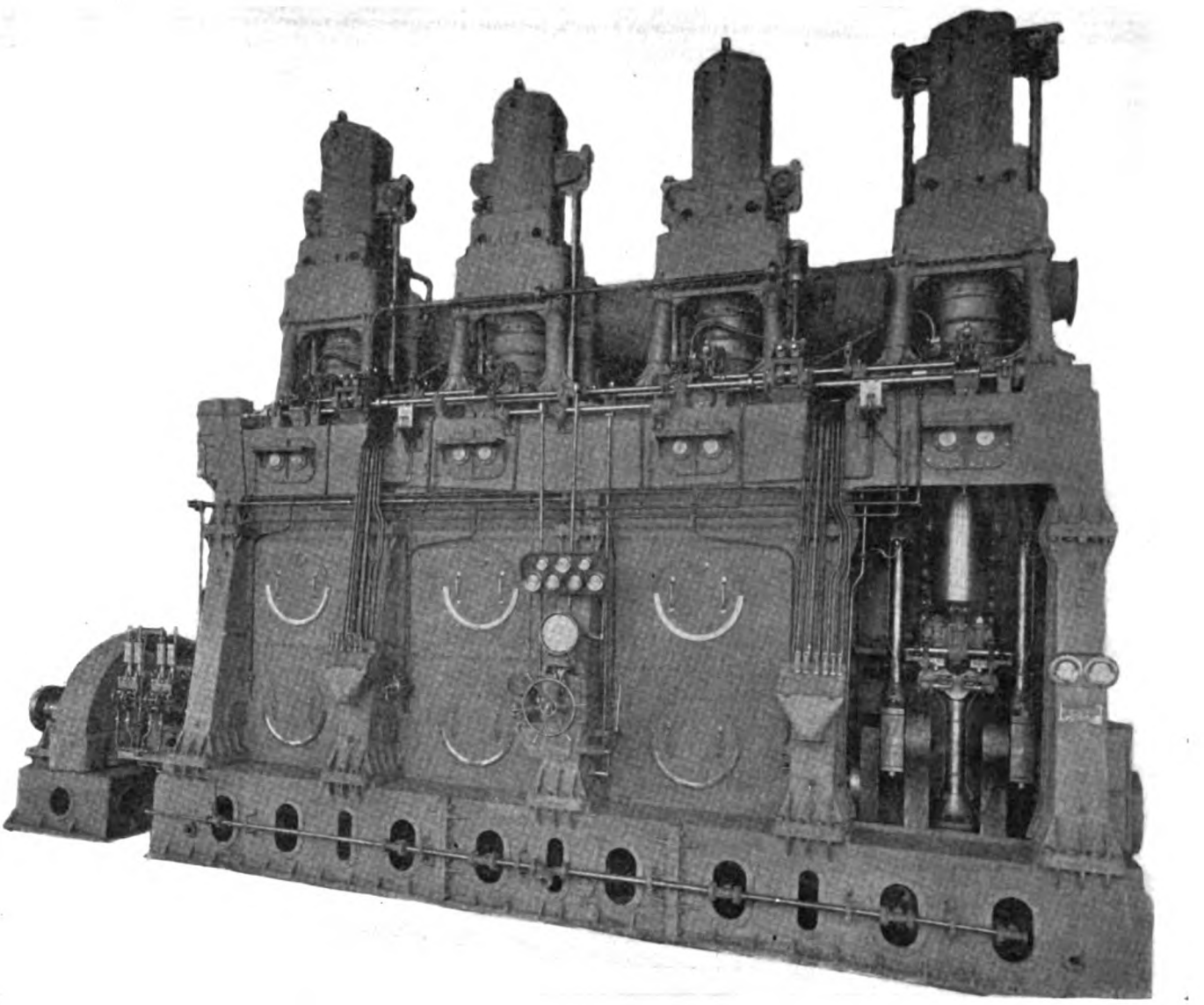

Fig. 3.—Side View of Main Engine of Motorship Henry Ford II

Sun-Doxford Engines of the Henry Ford II

First Application of Large Diesel Engines on a Great Lakes Bulk Freighter—Details of the Engines

THE two motorships now under construction for the Ford Motor Company at the plants of the American Ship Building Company at Lorain, O., and the Great Lakes Engineering Company at Detroit, Mich., have attracted more attention and have undoubtedly given rise to more extended discussion and comment than any other vessels at present being built in the Great Lakes district.

Ford Vessels Have Unusual Features

While these vessels, in general design, do not vary greatly from the usual type of large lake ore-carriers, and the hull construction is similar to that found in other recent lake ships, the propelling machinery is an entire departure from anything previously attempted in lake practice and in the matter of fittings and equipment there are many novelties and an elaborateness of detail never before equalled.

Even in their launching, these ships are in a class by themselves, the electric releasing gear, which was described in our last issue, not having previously been used on the Great Lakes.

The first ship, *Henry Ford II*, which was launched at Lorain on March 1, has the following general dimensions:

Length overall	611 feet
Length between perpendiculars	590 feet
Breadth, molded	62 feet
Depth, molded	32 feet
Depth of double bottom, center	5 feet 5 inches
Depth of double bottom, side	5 feet 3 inches
Load draft	20 feet

Hull Construction

The hull, which is of the usual arch type of construction, has a double bottom extending all fore and aft, and side tanks 6 feet wide to a height of 21 feet above the base line. There are three watertight, one partial watertight and two

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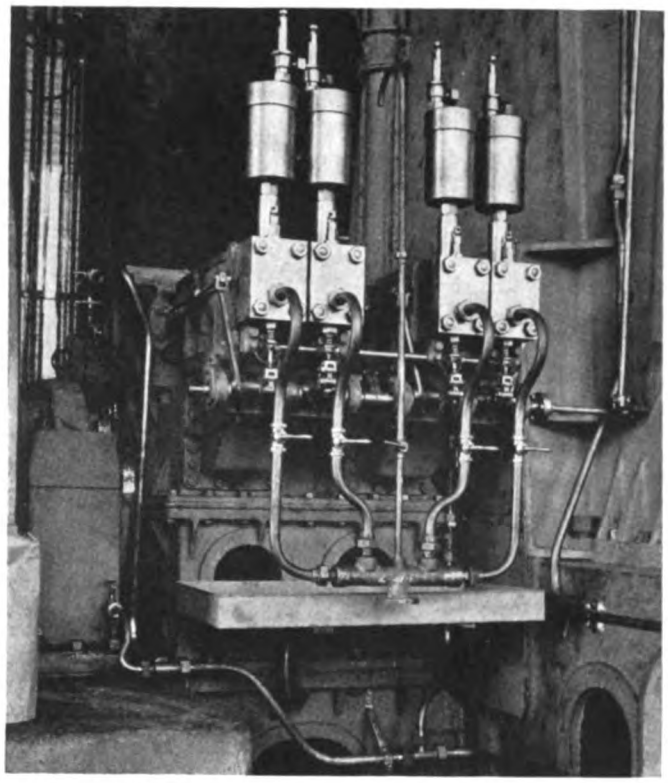

Fig. 4.—Oil Fuel Pumps

screen bulkheads, the latter being built on the staggered plating plan which was illustrated in the article on the steamer *John K. Field* in our April issue.

The main cargo hatches are 18 in number, 40 feet wide, athwartships and 12 feet long, fore and aft; spaced 24 feet centers. They have sectional steel covers, operated by two special Lidgerwood electric winches.

The quarters for the officers and crew are unusually commodious, and the special rooms forward, for the owner, will be finished and decorated in a manner far exceeding, in elaborateness, anything previously attempted on a cargo vessel.

PROPELLING MACHINERY

The principal interest in these vessels attaches to the propelling machinery, it being the first installation of large Diesel engines on the Great Lakes.

The engines for both vessels are being constructed by the Sun Shipbuilding and Dry Dock Company of Chester, Pa., and are of the well known Sun-Doxford opposed piston type, there being this difference, however, from the Diesel engines previously built by the Sun Company: that the scavenging pump is independent and not driven off the main engine, thus making the latter shorter and more compact.

DETAILS OF MAIN ENGINE

There are four cylinders 23½ inches in diameter, each piston having a stroke of 45½ inches, the combined, or effective stroke being 91 inches. The approximate shaft horsepower is 3,000 at 85 revolutions per minute.

The oil fuel is fed to the cylinders on the solid injection system at a pressure of approximately 6,000 pounds per square inch, there being two fuel injection valves for each cylinder, one on each side near the center as indicated by the accompanying plans, Fig. 2. These valves are controlled by two camshafts, shown in section, which are driven from the main shaft by bevel gears and a vertical shaft at the after end of the engine. The front cam shaft and gear case are clearly shown in Fig. 3. The main fuel pump, which is the only auxiliary operated by the main engine, is located at the after end of the engine, and is driven directly from the main shaft, as shown by Fig. 4. The auxiliary fuel pump, although motor driven, is an exact duplicate of the main pump. Both of these pumps were built by the Sun Company.

The scavenging air enters through the ports shown just above the lower piston (Fig. 2) and the exhaust ports are at upper end of the cylinder, appearing below the upper piston. It will be seen that this arrangement insures most efficient clearing of the cylinder after each power stroke.

The advantages claimed for the opposed piston engine have been often described, but a repetition of the main points seems in order:

1. Each unit is self-contained and approaches, closely, a perfect balance; the thrust in the center connecting rod being equal to the

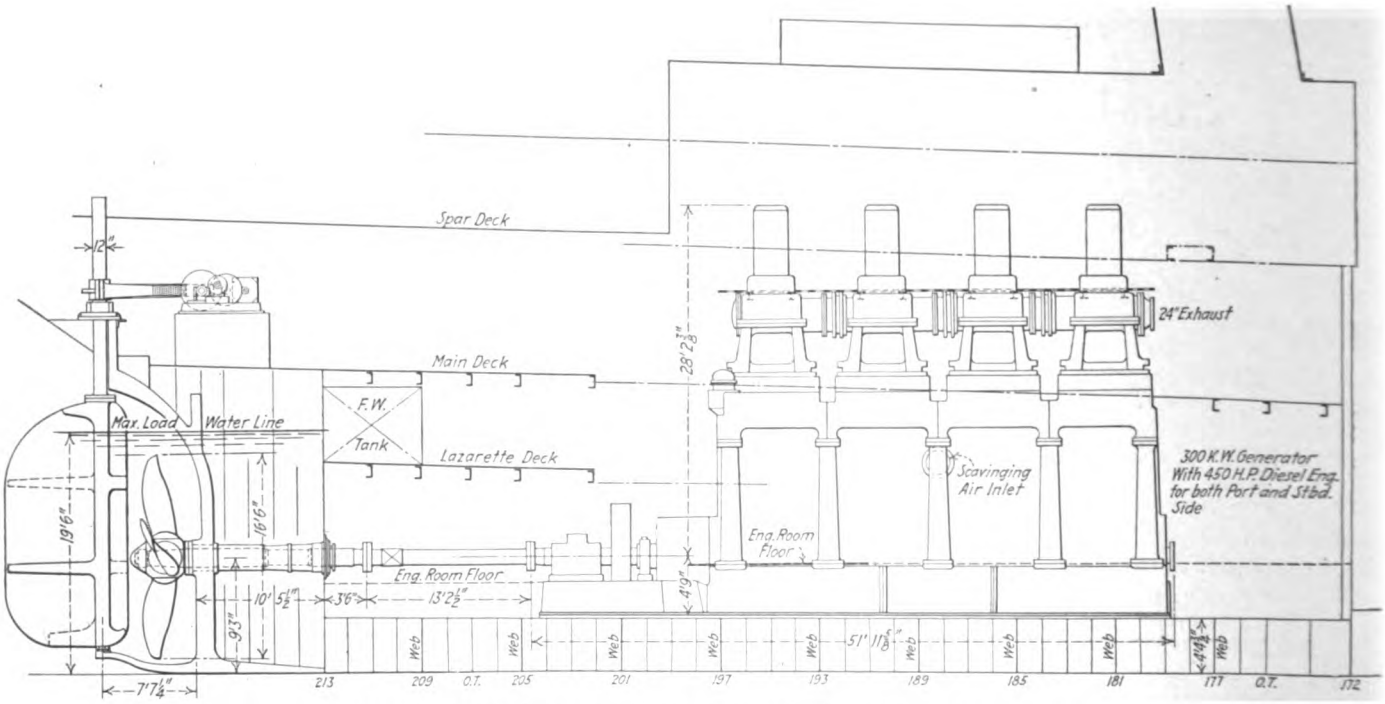

Fig. 5.—Longitudinal Section Through Machinery Space

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pull on the two side rods, with the result that the crankshaft practically floats in the bearings.

2. For the same reasons as cited in the preceding paragraph, there is little strain on the housings, aside from that arising from the weight carried.

3. The compression and mean effective pressures are relatively low.

4. The engine can be run continuously at a very low rate of revolution (15 to 17 per minute).

5. Very rapid maneuvering is possible, reversal occupying about 4 seconds.

Scavenging air is supplied by two General Electric rotary compressors, of 12,000 cubic feet capacity, driven by 180 horsepower motors. The maximum pressure is 2 pounds per square inch but for ordinary working conditions 1½ pounds is found sufficient.

Compressed air, in these engines used for starting and maneuvering only, is furnished by a Worthington compressor of 150 cubic feet capacity, the maximum pressure being 700 pounds per square inch. There is also an auxiliary compressor of the same type, having a capacity of 30 cubic feet with a maximum pressure of 250 pounds per square inch.

As in practically all first class motorships, the auxiliaries, both deck and engine room, are electrically driven. Power for this purpose is furnished by two Worthington, two cycle, solid injection Diesel engines of 450 brake horsepower each, driving Crocker-Wheeler generators of 300-kilowatt, 230-volt, direct current. These engines each have six cylinders 15¼-inch diameter and 16-inch stroke, and operate at 275 revolutions per minute.

While the advisability, from a purely financial standpoint, of employing internal combustion machinery for driving the large lake freighters, has been questioned by many ship operators and engineers, there is no doubt that, from the viewpoint of practical operation, this type of machinery has many advantages. No expense nor care has been spared in making the new Ford ships as nearly perfect as modern engineering development will permit, and their advent will be looked for with the greatest interest, on the seaboard, as well as the Great Lakes.

Practical Diesel Engineering

Louis R. Ford

IN the July issue of MARINE ENGINEERING AND SHIPPING AGE will be published the first of a comprehensive series of practical articles on "Practical Diesel Engineering" by Mr. Louis R. Ford, a consulting engineer who is widely recognized as an authority on Diesel engines.

The forthcoming series of articles will deal with marine Diesel engine operation from the viewpoint of the man in the engine room who is charged with the duty of keeping the ship's machinery in efficient operating condition. While the author's general treatment of the subject will be intensely practical, it is believed that the Diesel engine operator can proceed with more confidence and intelligence if he understands the simple fundamental principles of Diesel engine theory. For this reason the introductory discussion will deal briefly with these elementary principles.

This will be followed by a consideration of the various component parts of the motorship power plant and their attendant maintenance problems that will be of interest to both the steam engineer who has had little or no experience with this comparatively modern type of machinery, and the Diesel engineer who is already meeting similar problems and solving them in his own way.

Louis R. Ford, author of the forthcoming seriesof articles on "Practical Diesel Engineering," went to sea at the age of 14, later serving an apprenticeship in a general jobbing machine shop and then enlisting in the Navy as a machinist where he was promoted through the various grades to warrant officer. In 1912, upon passing a competitive examination, he was commissioned an ensign and, after serving a year at sea, took a special course in the naval post-graduate school and later received a degree as master of arts in engineering at Columbia University.

Having specialized in Diesel engines, he was assigned to duty as chief engineer of the U. S. S. *Fulton*, the first large motorship built in the United States. During the world war he was attached to the submarine force in various capacities, organizing the engineering department of the U. S. Submarine School at New London, Conn., and later serving as engineer and repair officer at the submarine base, New London. In 1919 he became chief engineer of the naval tanker *Maumee*, the largest motorship in the world at that time.

Resigning from the Navy in 1919, with the rank of lieutenant-commander, he accepted a position as chief operating engineer with the Worthington Pump and Machinery Corporation where he spent three years in a general consulting capacity. In 1922 he became manager of the Diesel Engineering Department of the Morse Dry Dock and Repair Company, Brooklyn, N. Y., and in conjunction with this position has engaged in general Diesel engine consulting practice.

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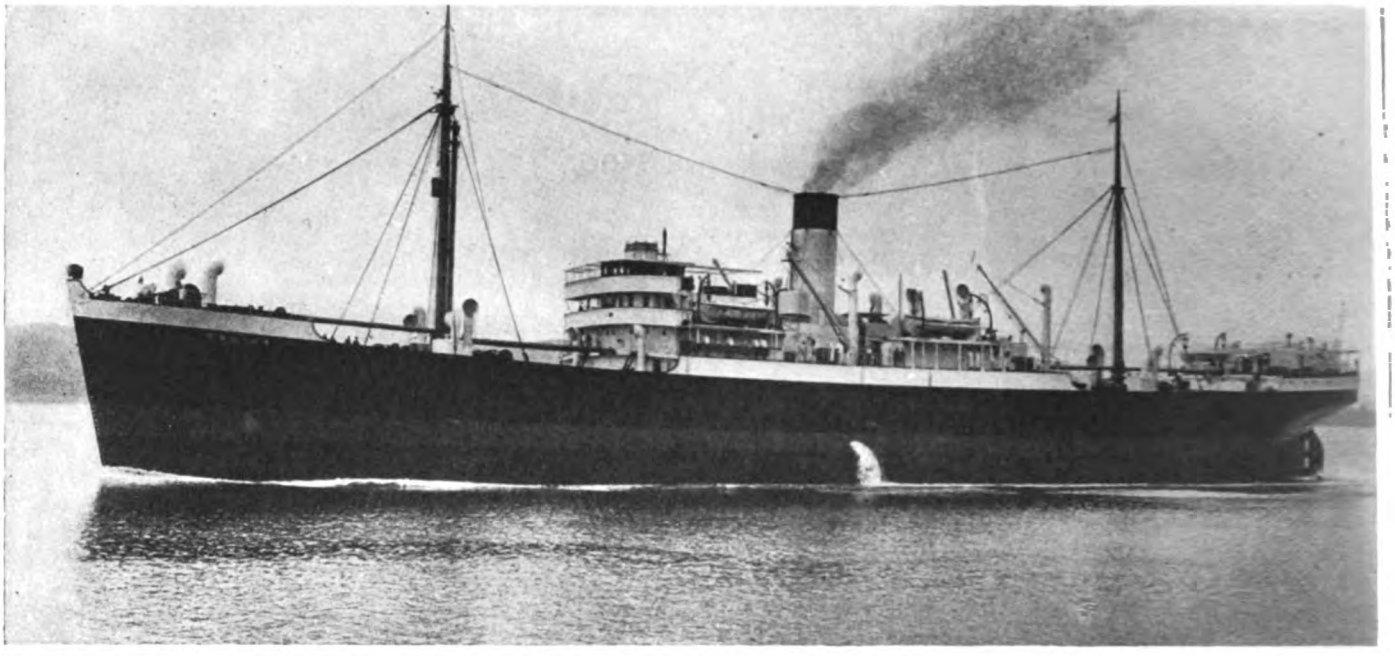

The 8,000-Ton Motorship Dolius, Fitted with Still Combined Steam and Oil Engines

M. S. Dolius, First Ship Fitted With Still Engines

Twin Screw Cargo Vessel of 8,000 Tons Deadweight Will Give Direct Comparison with Single Screw Motorship in Same Service

By Our Special London Correspondent

IT is now almost five years since the engineering world was surprised by the publication of details of a new type of oil engine known as the Still, intended mainly for marine work. It was claimed that with this design a higher thermal efficiency was attained than had previously been recorded with any prime mover, and so great was the impression made that licenses for manufacture were taken up almost at once by some leading engineering firms. It is an example of the long period of experiment required for the practical realization of an inventor's aim, that the first ship to be equipped with Still engines has only just been completed.

The vessel in question is the *Dolius* built and engined on the Clyde by Scotts' Shipbuilding & Engineering Company for the Blue Funnel Line (Alfred Holt & Company). On the occasion of the trials in April, engineers, shipbuilders and shipowners from all parts of Europe were present. Apart from the fact that the design of the machinery is entirely novel, the large amount of interest evinced was due to the fuel economies which it is said are achieved. Prolonged trials demonstrated that the consumption at full power was no more than 0.35 pound and it is stated that the total amount of fuel used for this vessel of 8,000 tons deadweight operating at a speed of 11 knots was only 8 tons.

The *Dolius* is 423 feet overall, with a molded breadth of 52 feet, a depth of 32 feet and a draft at full load of 25 feet 6 inches. She has been built for the Eastern trade and the machinery consists of two Still engines, each developing 1,250 brake horsepower at 120 revolutions per minute. The four cylinders are 22 inches bore and 36 inches stroke and the engines have little of the appearance of Diesel motors, owing to the absence of mechanically operated valves. There are no cylinder covers as the whole jacket is cast in one piece, and the cylinder liners are very thin, being provided with strengthening hoops of steel.

The Steam Plant

The temperature of the circulating water around the liners is 350 degrees F. and it is delivered from the cylinders to a boiler (one for each engine) arranged at the top of the engine room. Owing to the high temperature, steam forms automatically in the boiler at a pressure of 120 pounds per square inch. This steam is then led through a lagged pipe to the under side of the piston of one of the four working cylinders. On the upward stroke of the piston, therefore, the steam enters through oil controlled valves, expands, does work on the piston and is discharged on the downward stroke through exhaust valves. It then enters another pipe and passes to the under side of the pistons of the other three cylinders, the object being for the four cylinders thus to form a complete steam engine working expansively.

The steam is discharged from the three low-pressure cylinders at a vacuum of say 10 inches and is then used to drive a turbine coupled to a turbo blower which supplies scavenging air for the combustion side of the working cylinders. This blower is of the high speed type running at about 3,000 revolutions per minute. Finally, the steam reaches the condenser and after condensing, enters the water circulating system once more. The exhaust gases are used, so far as possible, for raising the water temperature. On each engine is a small regenerator through which the circulating water passes, these being exhaust heated. The gases also pass around the tubes of the boiler, and through a feed-heater before they are finally discharged.

While there is no doubt that high thermal efficiency, and

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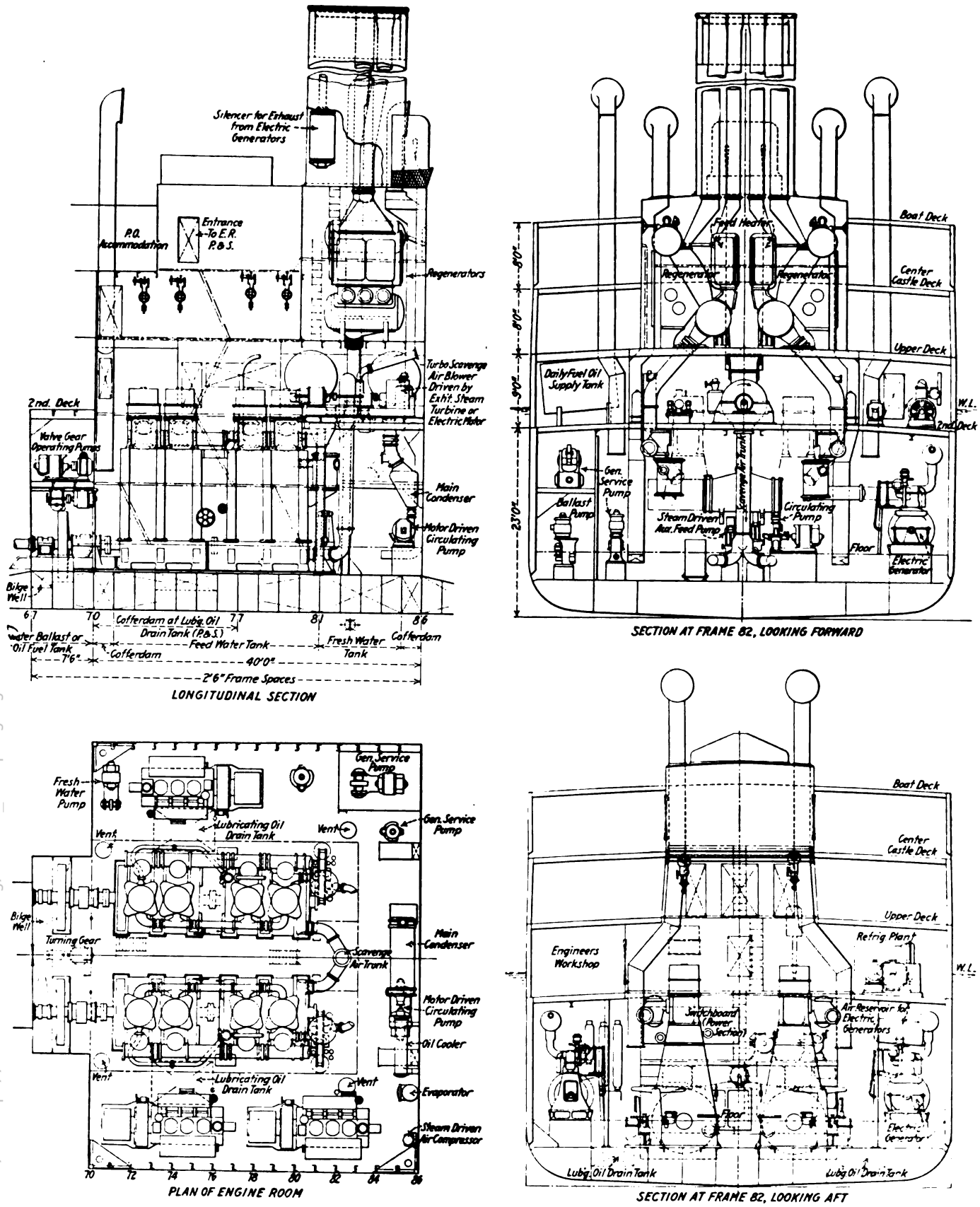

Machinery Arrangement of M. S. Dolius

therefore great economy, can be effected by making use of all the available heat in this way, it might be thought that considerable complications have been introduced. No doubt, many sea-going engineers will consider this to be the case, but the claim of the inventor and builders is that while a substantial amount of steam plant has been added, the air compressors, air reservoirs and air piping have been eliminated and that, in effect, the steam plant merely takes the place of the arrangements for supplying compressed air in the normal motorship. On the whole, however, it must be

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said that the Still engines give the appearance of greater complication, and it would seem that the cost must be higher than with the ordinary design.

Automatic Fuel Valves

In order to avoid the necessity of having compressed air for fuel injection, a novel mechanical and automatic system has been devised. With most Diesel engines using solid injection, the fuel pump supplies oil through mechanically operated valves in the cylinders. In the Still motor, the fuel valves in the center of the top of each cylinder are entirely automatic. The timing of the injection of the fuel is effected from the fuel pumps which are driven direct from cams on the crankshaft. This would seem a step in the right direction, and it is to be noted that a somewhat similar arrangement has been adopted on the new types of Camel-laird-Fullagar opposed-piston engine.

The motors in the *Dolius* are started up and maneuvered by steam, so that no starting air valves are needed. For this purpose it is, of course, necessary to light the burners under the boilers, and it is a standing instruction for the engineers that this must be done when approaching harbor and when maneuvering is likely to be carried out. When the ship is under way, however, the burners are extinguished.

Engines Operate on Two-Cycle Principle

On the internal combustion side, the engines operate on the two cycle principle, hence the need for the turbo scavenging blower referred to above. When full power is not being developed, there is insufficient steam to drive this blower by means of the turbine and, consequently, it is coupled to an electric motor on the other side. When necessary, therefore, power is supplied to the motor, augmenting that delivered from the steam turbine.

Auxiliaries Are Electrically Driven

It is a somewhat curious fact that on a ship where steam is actually generated from the heat of the exhaust gases, and circulating water of the Diesel engine, no attempt has been made to utilize it for driving the auxiliaries, apart from the turbo blower. All the pumps, the winches and steering gear, and other accessories, are electrically operated and there are three 100-kilowatt Diesel driven generators installed in the engine room. These are of the normal Burmeister & Wain design, although manufactured under license by Allens of Bedford. There are two Hele Shaw rotary oil pumps for the supply of oil under pressure for actuating the steam valves of the main engines. These are of fairly large size, each driven by a 30 horsepower electric motor. It is not an essential part of the Still principle that the steam valves should be operated in this manner, and possibly piston valves, or other forms of well-known steam actuating gear would have tended towards simplicity.

Results Will Be Compared with Those of Sister Ship

Leading British shipowners are very anxious to determine the most satisfactory type of internal combustion engine for their new ships. It is no doubt for this reason that the Blue Funnel Line has built the *Dolius* of exactly the same dimensions, tonnage and speed as one of their existing single screw motorships, the *Medon*. This latter craft, which has been in service about a year, is propelled by a 2,000 brake horsepower Burmeister & Wain four cycle single acting engine, and is engaged upon the same service upon which the *Dolius* will be placed. The results of the two vessels will thus be directly comparable and after a year or two's operation it will be easy for the owners to decide whether the undoubted advantages of the Still design in the matter of reduced fuel consumption are not obtained at the expense of other desirable features, such as low cost of upkeep and maintenance.

Twenty-six Inch Hydraulic Dredge

By R. R. Roane*

W. H. GAHAGAN, INC., of Brooklyn, N. Y., recently designed and built at Chesapeake City, Md., a 26-inch hydraulic dredge of 1,350 gross tons displacement which is equipped with unusually powerful machinery. Since completion on December 1, 1923, the dredge has been in operation on contract "C" of the Chesapeake and Delaware canal under control of the Federal Government.

The principal dimensions of the dredge are as follows:

Length overall	155 feet
Beam, outside of planking	45 feet
Depth, over planking	12 feet
Depth of ladder well	25 feet
Width of ladder well	13 feet 6 inches

The hull is of Douglas fir, of exceptionally heavy design with two structural steel trusses running the entire length of the hull spaced 22 feet between centers. The rigging consists

Hydraulic Dredge and Pipe Line in Operation

of a structural steel A-frame, strong backs and spud gantry carrying two black gum spuds 30 inches diameter and 55 feet long with cast steel points supported with plow steel guy ropes and hog rods.

Steam is supplied at a working pressure of 225 pounds per square inch by four Heine watertube boilers with a total heating surface of 12,500 square feet and a total maximum evaporation with natural draft of 54,000 pounds per hour. The boilers are erected in two batteries and are equipped with Coen oil burners. The four boilers have a total commercial horsepower of 1,250, A. S. M. E. rating.

The main pumping unit consists of a vertical triple expansion heavy duty marine engine with cylinders 18¼ inches, 29 inches and 48 inches diameter by 21 inches stroke built by the New York Shipbuilding Corporation, Camden, N. J., and capable of developing 1,800 indicated horsepower at 225 revolutions per minute with 200 pounds of steam at the throttle. The engine is mounted on a self-contained base and coupled direct to the main centrifugal pump which has an impeller 104 inches diameter by 22½ inches wide. The suction and discharge are 26 inches diameter. The pump was designed by the owners and built by the Birdsboro Steel Foundry and Machine Company. The entire main pump unit has a total weight of 210,000 pounds.

The winder machinery consists of one Bucyrus five-drum winder, with steam ram frictions, driven by a 10-inch by 12-inch double cylinder horizontal reversible engine of 250 indicated horsepower. The winder is capable of exerting a pull of 38,000 pounds on a single line, and has winch shafts extending to the outside of the deckhouse on each side.

The cutter engine, supplied by the Flory Manufacturing Company, is of the double cylinder type 13 inches by 12

*Mechanical engineer, W. H. Gahagan, Inc., Brooklyn, N. Y.

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inches capable of developing 400 indicated horsepower. Mounted on the forward deck, the crank shaft carries a steel pinion engaging a large steel gear below the deck with the shaft passing through the trunnion to the intermediate train of gears and then to the bevel gears on the ladder shaft. The maximum torque of the cutter is 38,000 pounds. The cutter itself is of special steel of the Robinson type with seven blades with removable cutting edges. It is 60 inches long and 84 inches in diameter.

The ladder is of special design 78 feet long and 7 feet deep at the hull and built of heavy structural steel. The shafting is 10 inches diameter with forged couplings carried on 7 bearings with a marine thrust.

The auxiliary machinery includes:

One R. and D. paracoil feedwater heater capable of heating 54,000 pounds of water per hour from 100 to 225 degrees F.
Two Schutte and Koerting 2½-inch high pressure double tube injectors.
Two Worthington vertical duplex feed pumps 10 inches by 7 inches by 10 inches.
One Worthington vertical duplex bilge pump 7½ inches by 10¼ inches by 10 inches.
One vertical Worthington duplex general service pump 7½ inches by 9 inches by 10 inches.
One Worthington main surface condenser of 3,200 square feet cooling surface.
One Worthington centrifugal circulating pump, capable of delivering 5,000 gallons per minute against a 25-foot head, driven by a 9-inch by 9-inch vertical engine at 360 revolutions per minute.
One auxiliary surface condenser of 1,200 square feet cooling surface mounted over a horizontal combined air and circulating pump 12 inches by 14 inches by 14 inches by 12 inches.
One General Electric 10-kilowatt, 110-volt, direct current generating set.

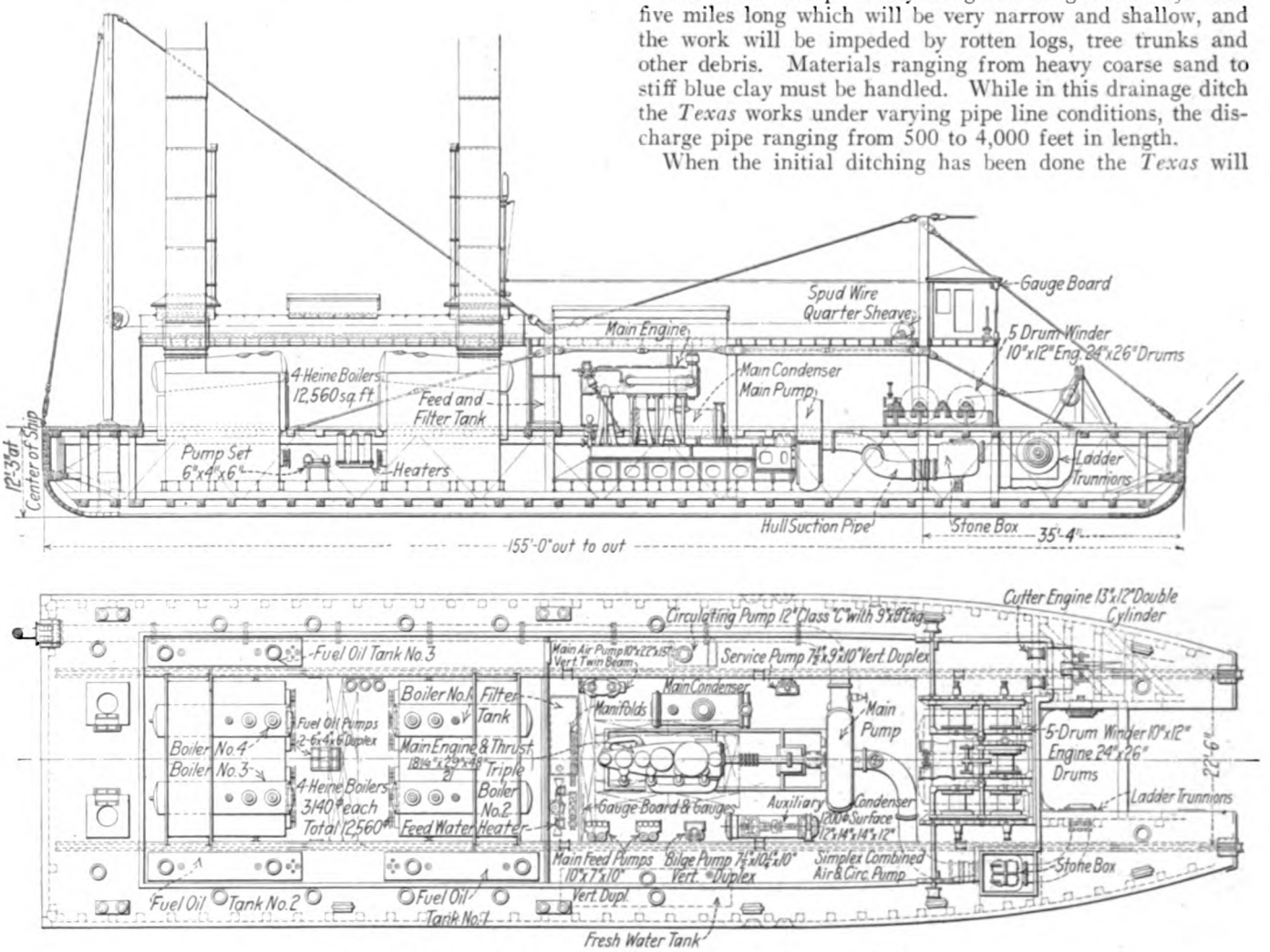
In operation the dredge requires an engine room crew of only four men consisting of an engineer, oiler, fireman and water tender.

Diesel Electric Dredge Shows Marked Economy in Operation

THE 15-inch Diesel electric dredge *Texas* owned and operated by The Long-Bell Lumber Company in their development work at Longview, Washington, was designed by James H. Polhemus, general manager and chief engineer of The Port of Portland, to fit the peculiar conditions under which it would operate and is very staunchly built, suitable for heavy digging.

The *Texas* was primarily designed to dig a drainage ditch five miles long which will be very narrow and shallow, and the work will be impeded by rotten logs, tree trunks and other debris. Materials ranging from heavy coarse sand to stiff blue clay must be handled. While in this drainage ditch the *Texas* works under varying pipe line conditions, the discharge pipe ranging from 500 to 4,000 feet in length.

When the initial ditching has been done the *Texas* will do channel maintenance work in the Columbia River at Longview, where the current is quite strong and the river becomes very choppy at times.



Inboard Profile and Hold Plan of 26-Inch Hydraulic Dredge

MAIN PARTICULARS

The following are the principal dimensions of the dredge:

Length of hull	104 feet
Width of hull	32 feet
Depth of hull	8 feet 6 inches
Draft (forward and aft)	4 feet 6 inches
Fuel capacity	150 barrels
Main Diesel engine	525 brake horsepower
Main generator, 2,300 volts	450 k.v.a.
Auxiliary surface-ignition engine	16 brake horsepower
Auxiliary generator, 220 volts	9 k.v.a.
Main pump motor, 2,200 volt	350 horsepower
Hoist motor, 2,200 volt	40 horsepower
Current motor, 2,200 volt	50 horsepower
Two service pumps, each 220 volts	10 horsepower
Two oil-transfer pumps, each 220 volts	1 horsepower

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The motors on the dredging pump, hoists and cutter are 2,200 volt, 40 degree variable speed, slip ring motors, good for continuous overload and capable of 33 percent speed reduction. The small pump and shop motors are squirrel-cage induction motors of 220 volts. The current throughout is alternating three phase 60 cycle.

Power Plant

The main power plant is a 525 brake horsepower 6 cylinder Pacific-Werkspoor Diesel engine, 15-inch bore and 23⅝ inch stroke, operating at 225 revolutions per minute. There are two fuel oil tanks fitted with hot water heating coils which act also as settling tanks. The engine is fitted with a radiator type pipe-cooling system to conserve the circulating water used for cooling the engine. This is necessary on account of the muddy water in the canal. A Maxim silencer is provided, as well as a full set of recording pyrometers, air gages, speed regulators, etc.

The main generator is designed to fully take care of the overload possibilities of the main Diesel engine, and is driven from it through a flexible coupling. It is rated as 450 k.v.a., 2,300 volts, 3 phase, 60 cycle. Its exciter is direct connected. Transformers are provided for stepping this current down to 220 volts for all motors except the main pump hoist and cutter motors.

The engine for the auxiliary generating set is a 16 brake horsepower Skandia surface ignition engine, burning Diesel oil of 24 degrees Baumé and provided with electric starting. It drives a 9 k.v.a., 220 volt, 3 phase 60 cycle generator and a two-stage air compressor. This compressor is used to pump up the starting and fuel injection air bottles, should pressures in these be lost. The auxiliary generating set is to furnish lights and operate any of the pumps when the main engine is shut down.

The main and auxiliary generators, as well as the main pump motor, are controlled from a switchboard in the engine room. The winch and cutter motors are controlled from the lever room. Automatic safety switches prevent the accidental throwing of the 2,300 and 220 voltages together.

Dredging Pump

The dredging pump is designed to operate with impellers of two different diameters, the smaller one for the shorter pipe line and the larger one when the discharge line is long. The pump is driven by a 350 horsepower 2,200 volt, 3 phase, 60 cycle, 450 revolutions per minute variable speed, 40 degree, slip ring motor. The speed reduction is 33 percent and a continuous overload capacity without excessive heating is provided. The flexibility obtained through the variable speed and overload characteristics of the motor, combined with the two sizes of pump impellers, allows the dredge to be operated to its fullest efficiency on all lengths of pipe line up to 4,000 feet.

The dredge pump is primed by a hydraulic ejector connected to service pumps, of which there are two, driven by 10 horsepower motors and which furnish circulating water for the main pump bearing seal, cutter head bearings, fire service and for priming the dredging pump. Only one of these pumps is operated at a time, the other being kept in reserve. The Diesel engine has its own fuel oil, lubricating oil, and circulating water pumps, which are in duplicate and are an integral part of the engine.

The hoist is an electric-driven, five drum, heavy duty winch designed specially for dredging purposes. The motor is a 40 degree, 40 horsepower, 2,200 volt, 900 revolutions per minute variable speed, of slip ring type.

The ladder is about 48 feet long of structural steel and designed to dig in shallow water. The cutter shaft is 6 inches in diameter, the suction pipe 15 inches inside diameter. The cutter is of cast steel, with removable steel blades, designed to prevent obstructions from entering the suction pipe and thereby cause loss of vacuum. The cutter is driven by a 50 horsepower, 2,200 volt, 3 phase, 60 cycle 900 revolutions per minute, variable speed 33 percent 4 degree slip-ring motor.

There are four fuel tanks, 4 feet in diameter by 15 feet long; one lubricating oil tank, 3½ feet in diameter by 3 feet long, and one fresh water tank, 3½ feet in diameter by 10 feet long.

Hull Construction

The hull is built of Douglas Fir, having 6-inch solid gunwales. There are four longitudinal bulkheads, two of which run the full length of the hull and are diagonally sheathed with 1-inch plank. There is a cross bulkhead at the after end of the ladder well and one at the center of the hull between the engine and pump hatches.

The Diesel electric type was chosen on account of its operating economy and having in mind the fact that when the Long-Bell Lumber Company's generating plant, now under construction is completed, current will be available and the dredge can be converted into a straight electric dredge.

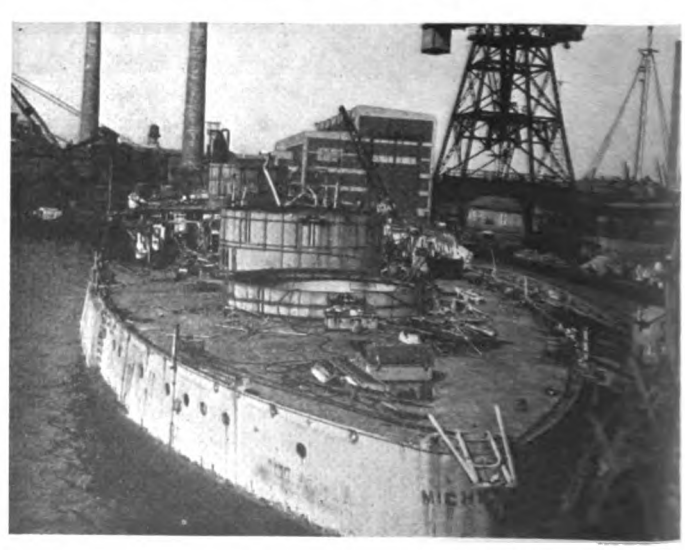
Diesel Electric Dredge Saves $15,000 a Year

The estimated saving in the operation of this Diesel electric dredge over a steam dredge of the same size is about $15,000 per year.

A table is herewith given showing the average monthly field operating costs of the 15-inch Diesel electric dredge *Texas* and the 15-inch steam dredge *Kentucky* of the Long-Bell Lumber Company's fleet taken from their records over an operating period of four months.

Monthly Operating Costs

	15-Inch Diesel Electric Dredge *Texas*	15 Inch Recip Steam Dredge *Kentucky*
Labor	$2,988.00	$3,463.00
Fuel oil	453.00	1,809.00
Lubricants	525.00	25.00
Operating supplies	1,700.00	1,640.00
Repairs	998.00	764.00
Towing	223.00	1,047.00
Sub-total	$6,687.00	$8,748.00
Overhaul and renewals	1,500.00	2,000.00
Insurance	422.00	336.00
Depreciation	1,122.00	503.00
Grand total	$9,731.00	$11,587.00
Cubic yards, month of February	82,892	67,841
Yards per hour	212	219.9
Yards per day	3,768	3,990.6
Cubic yards, month of March	104,409	99,764
Yards per day	3,867	3,440
Yards per hour	221	191



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Former Battleship Michigan Being Scrapped at Philadelphia Navy Yard

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Three-Cylinder 2,100 Horsepower Doxford Engine

With New Design, Using Diesel Oil, Fuel Consumption Is Only 0.35 Pound per Brake Horsepower Hour at Full Load

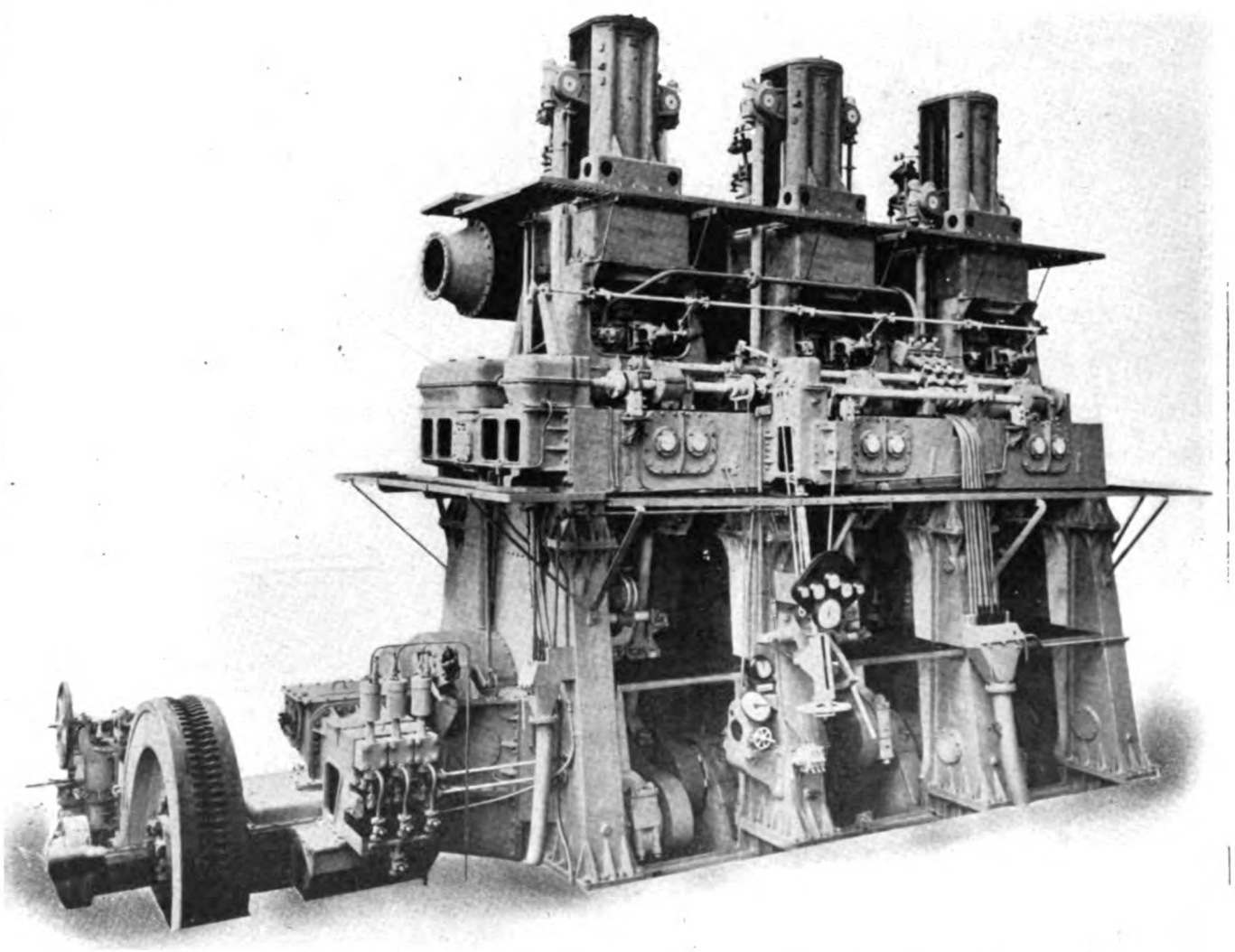
By Our Special London Correspondent

ONE of the most interesting motorships that has yet been built arrived in New York last month to load cargo for her maiden trip across the Pacific to the Far East. This is the *Silverelm* which has been built for the Silver Cedar Shipping Company, of London. It is designed to carry 8,000 tons, at a speed of 10 knots, and is the first large vessel to be equipped with an oil engine having only three cylinders. In this respect, the vessel resembles a normal tramp steamer with triple expansion reciprocating engines—a point that will appeal to the shipowner in search of simplicity in oil-engine construction.

The new engine is of the Doxford opposed piston type, and is a development of the standard four-cylinder 3,000 horsepower design as built by the Sun Shipbuilding and Dry Dock Company. It develops about 2,100 indicated horsepower or 1,850 brake horsepower at 85 revolutions per minute and is essentially intended for installation in single screw vessels, being suitable for the replacement of steam engines in converted craft. The bore of each cylinder is 21.28 inches and the stroke of the two opposed pistons 42.55 inches.

In the previous Doxford engines the scavenging pump is arranged in line with the cylinders and is driven from the crankshaft direct. In this new type the pump is operated from a beam lever driven from the center cylinder crosshead, and the circulating pump, general service pump and lubricating oil pump are driven in a similar manner. In other words, the engine is not dependent upon separately driven auxiliaries as is usually the case with motorship machinery.

Certain other constructional alterations have been made, rendering the motor somewhat different from the previous Doxford engines. The framework is arranged with single instead of double columns between the cylinders, and the drives for the two camshafts are by spur and bevel gearing and an intermediate vertical shaft at the after end, instead



A New Doxford Opposed Piston Oil Engine of 2,100 Indicated Horsepower

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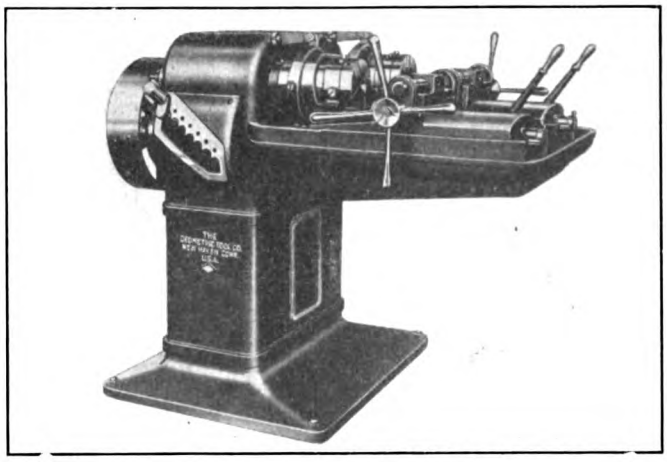
of two vertical shafts, one for each camshaft being fitted. This economizes in length as does the arrangement of the fuel pumps above the thrust block, with the result that the over-all length of the motor is 38 feet while its weight is 220 tons—substantially less per horsepower than the 3,000 horsepower Doxford motor.

The most remarkable thing about this new engine is the low consumption of fuel which has been attained. In the vessel, it is intended to run entirely upon boiler fuel oil, and the trials in the shop with this fuel showed a result of 0.375 pounds per brake horsepower hour. When running on what is termed Diesel oil, the figure achieved was 0.35 pound per brake horsepower hour at full load. If these results can be substantiated, as apparently they can, it would seem that this new design equals the Still engine in efficiency. It may be noted that a relatively high mean pressure is used in the cylinders, the normal figure at full load being 100 pounds per square inch. Several of these new engines are now under construction for single screw vessels.

Double Spindle Threading Machine

A MACHINE, designed primarily for threading work in which the threading time for both pieces is sufficient to allow the operator to check and start a second piece while the first is being completed, is now manufactured by the Geometric Tool Company, New Haven, Conn. A number of threading combinations are possible with this machine.



Geometric Machine With a Wide Range of Threading Combinations

Both spindles may be fitted with die heads for external threading only or with collapsing taps for internal threading, or one spindle may carry a die head and the other a tap for handling work which requires both an external and internal thread. The same combination may also be employed for separate external and internal threading whenever work of such character is required.

The bed of the machine consists of a casting, carrying the two spindles, which are mounted in large bronze bearings. The spindles are driven by a single pulley, located at the rear of the machine, but they can be driven independently by means of the change gear levers at either side of the machine. Each carriage is fitted with a two-jaw chuck. The chuck is operated by a hand wheel, and special bushings or holders can be furnished to suit various classes of work. An adjustable swinging gage on the side of the carriage provides an accurate means of setting the work for a predetermined length of thread. An adjustable stop on the trip rod ahead of the carriage governs the opening of the die head and the length of the thread to be cut. The adjustable stop back of the carriage controls the closing of the die head.

Both spindles are operated and controlled in exactly the same manner. This facilitates the operation of the machine from the standpoint of production.

A single geared pump, driven from the main shaft by bevel gears and a flexible shaft, forces oil from the reservoir through the spindles and die heads against the work. When equipped with the collapsing tap or high speed tapping device, the oil is fed through pipes on the outside of the machine. The lubricating system may be easily removed for cleaning and inspection.

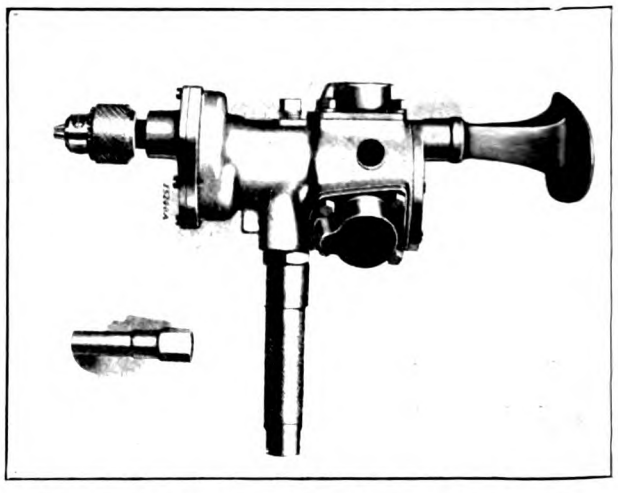
The change gear levers on the sides of the machine control the spindle speeds independently, and may be set to furnish the proper speeds for the threads being cut.

This machine will cut threads of the following diameters: 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8 and 1 1/2 inch. The greatest cutting length at which the swinging gage can be set at one time is 9 inches. With resettings, a length of 14 inches may be obtained. The floor space required is 48 inches by 65 inches. The speed of the countershaft is 296 revolutions per minute, and the net weight of the machine, 2,165 pounds.

New Light Weight Pneumatic Drill

A NEW size lightweight non-reversible pneumatic drill has been brought out by the Ingersoll-Rand Company, 11 Broadway, New York. This new drill is known as size "D" and is suitable for light drilling up to 9/16-inch diameter holes, and reaming up to 5/16-inch diameter.

The drill may be fitted with either breast plate, feed screw or grip handle and so made adaptable for a wide variety of work. The construction of this machine is very similar to that of the No. 6 and 600 drills which this company brought out about two years ago and which were powered for drilling up to 3/8-inch diameter.



Size "D" Non-Reversible Ingersoll-Rand Drill

The features of this type of machine are briefly—lightweight aluminum case, with steel bushings cast in all the bearing holes and the throttle hole; cast iron cylinders which are renewable and interchangeable and a special three cylinder motor. The renewable cylinders are a valuable feature, as any cylinder after long service, may easily be replaced and the motor made as good as new at slight cost.

The three cylinder motor has the rotating parts all accurately balanced, eliminating vibration and reducing wear and tear on the machine. The drill is economical in air consumption and cost of maintenance, is high powered, and every part is readily accessible for inspection.

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Wetted Surface*

By Henry H. Schulze†

WETTED surface is determined primarily for resistance calculations and to estimate weights of structural steel. In both cases the accuracy with which it is determined quite materially affects the final results.

*Paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1923.

†Superintendent of Estimating Division, Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa.

The total resistance of a vessel is usually considered to be composed of two groups: First, skin resistance, and second, residuary resistance; and with full-bodied vessels the former is two or three times the latter; hence any gain in the accuracy of determining the wetted surface allows of a latitude of two or three times this amount for determining the more difficult residuary resistance.

Similarly, shell plating and transverse framing are a fair portion of the total structure steel, and therefore an accurate determination of the wetted surface, which is a simple operation, will allow a considerable percentage of error in the more complex portions of the structure.

For these reasons it was considered desirable to make a

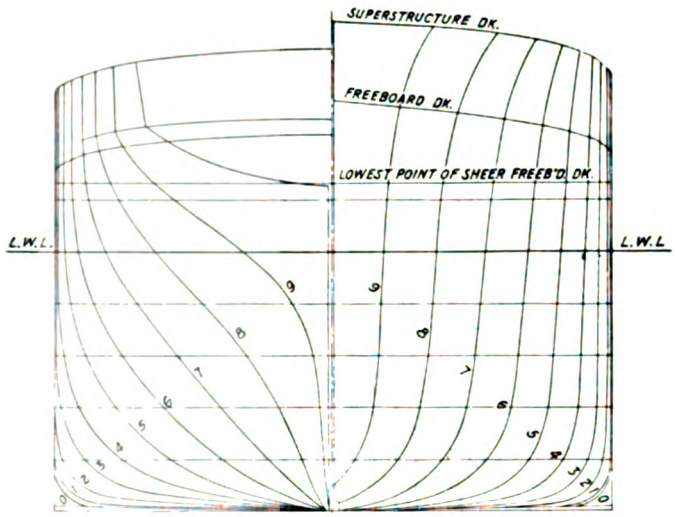

Fig. 1.—Cross Section of Standardized Lines

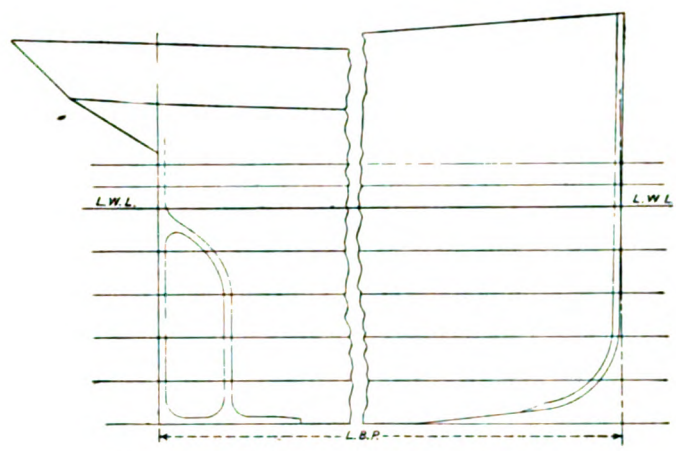

Fig. 2.—Profile of Standardized Lines

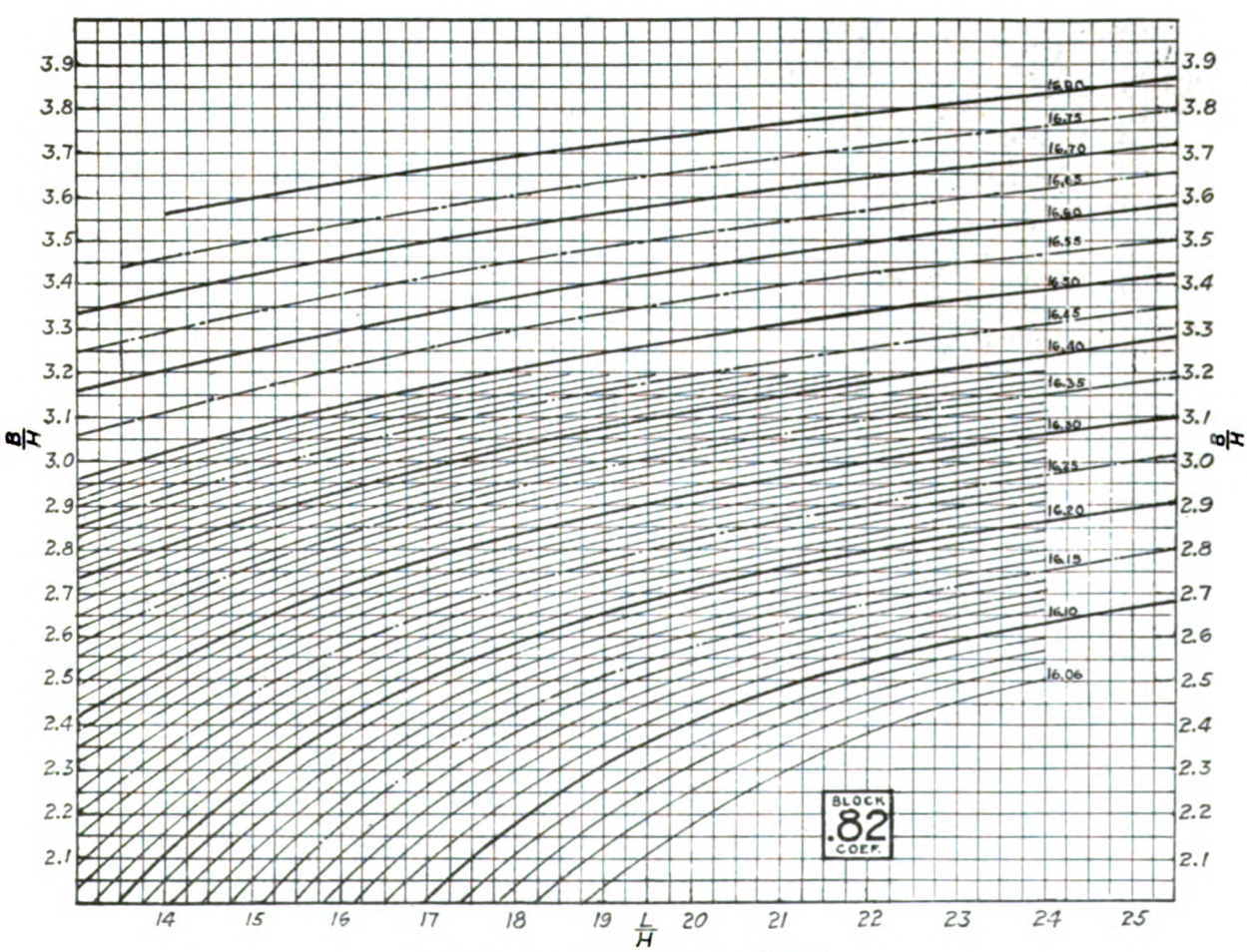

Fig. 3.—Values for C in $S = C\sqrt{D \times L}$

C = coefficient, S = molded wetted surface, D = molded displacement, L = length between perpendiculars, H = molded draft, B = molded breadth.

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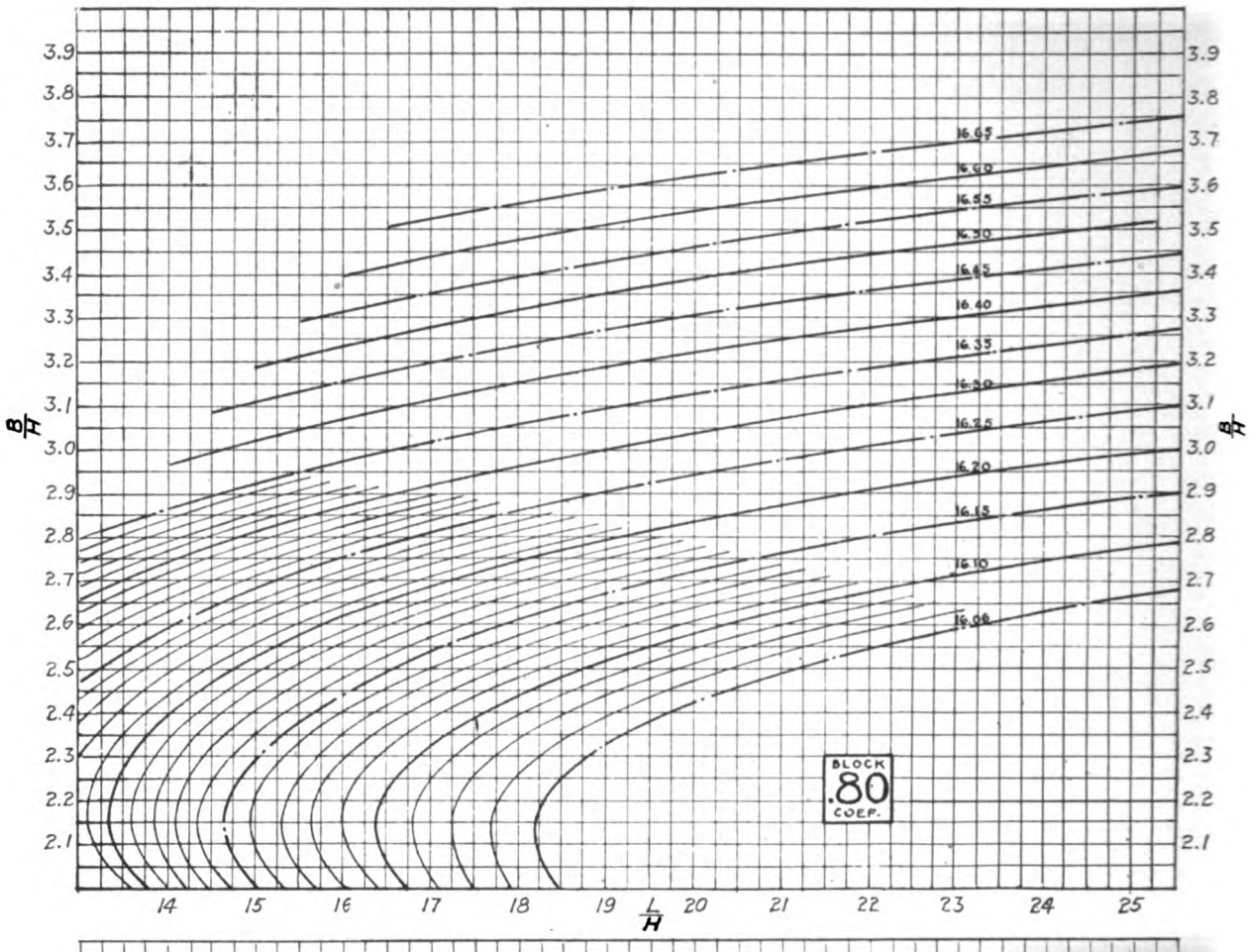

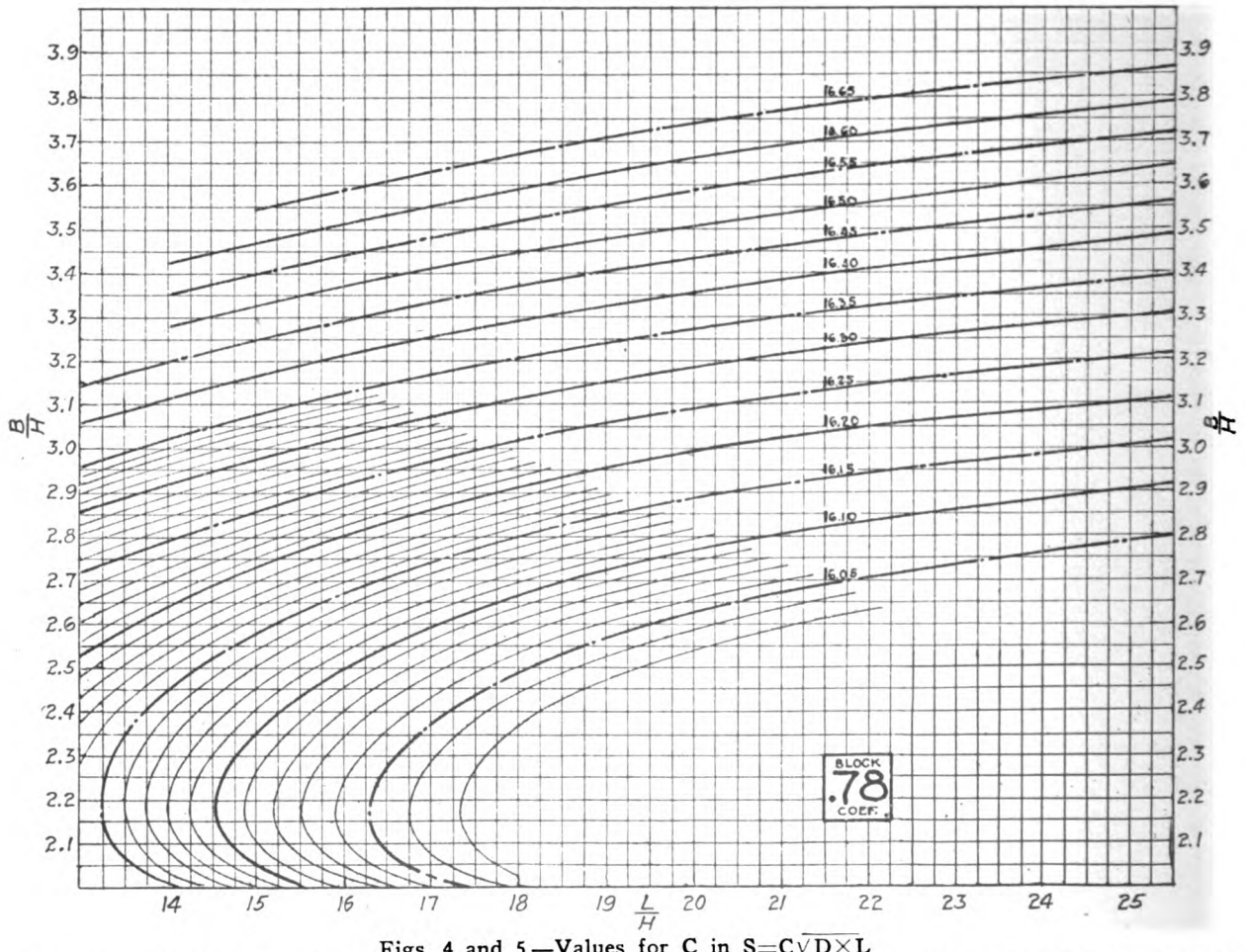

Figs. 4 and 5.—Values for C in $S=C\sqrt{D\times L}$

C = coefficient, S = molded wetted surface, D = molded displacement, L = length between perpendiculars, H = molded draft, B = molded breadth.

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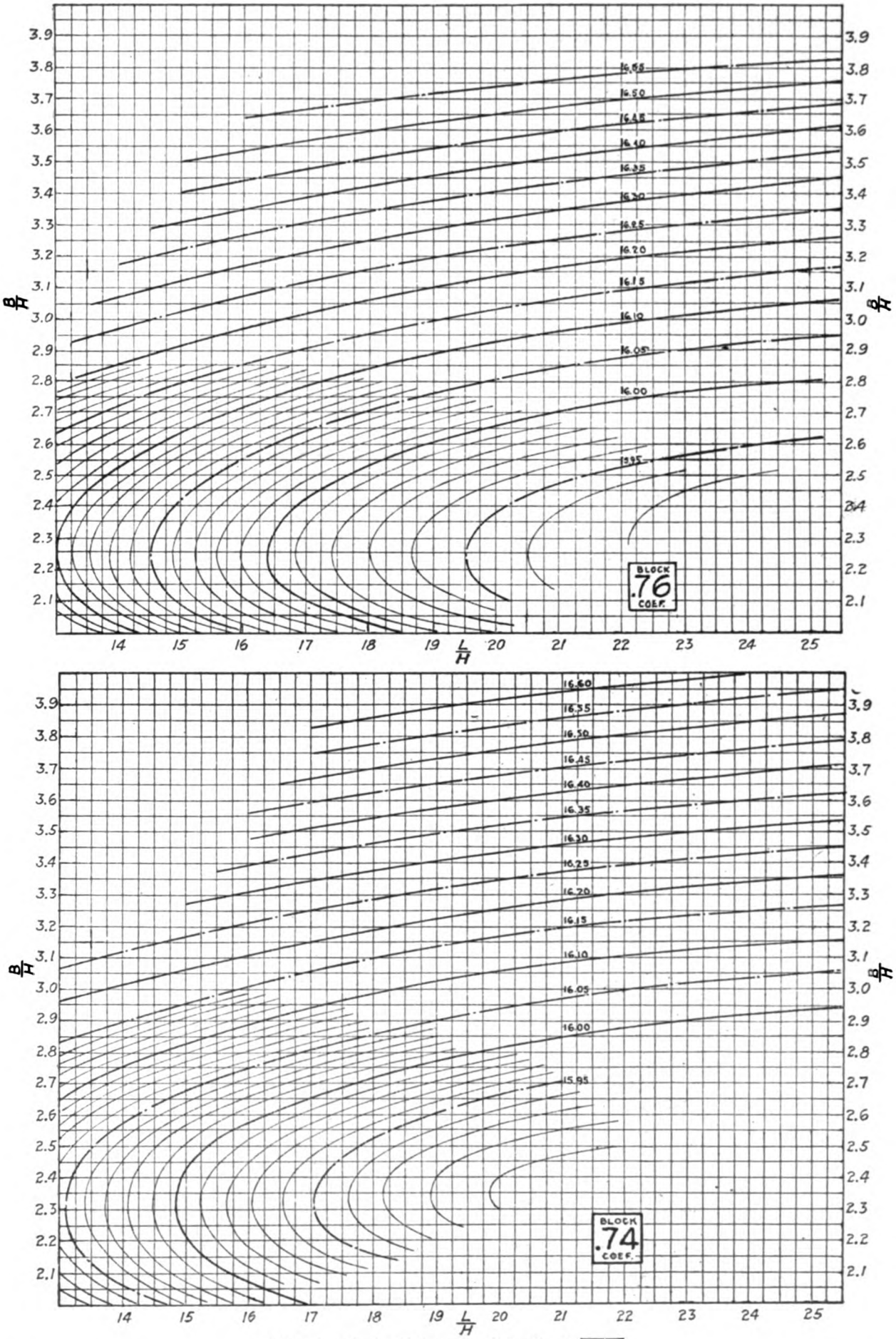

Figs. 6 and 7.—Values for C in $S=C\sqrt{D\times L}$

C = coefficient, S = molded wetted surface, D = molded displacement, L = length between perpendiculars, H = molded draft, B = molded breadth.

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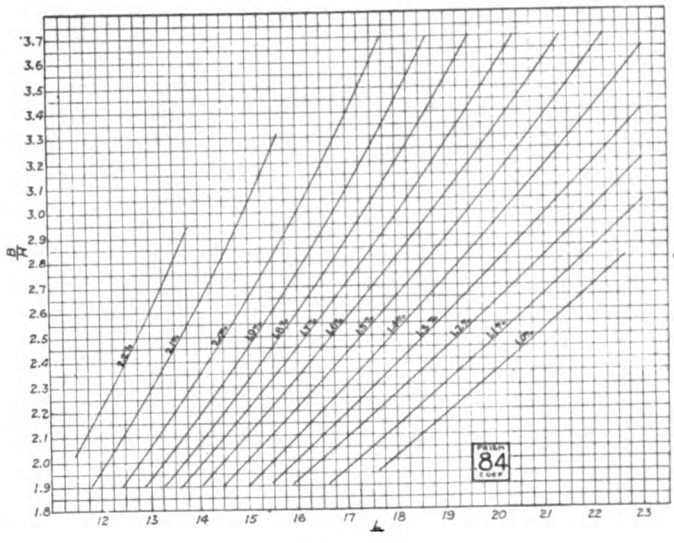

Fig. 8

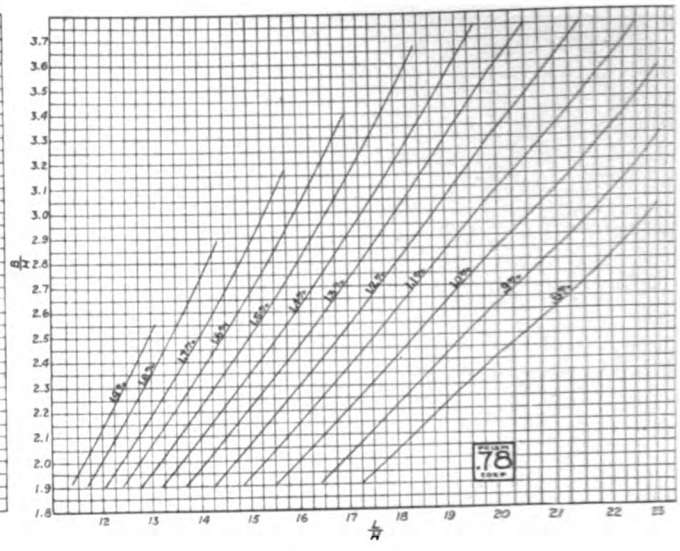

Fig. 11

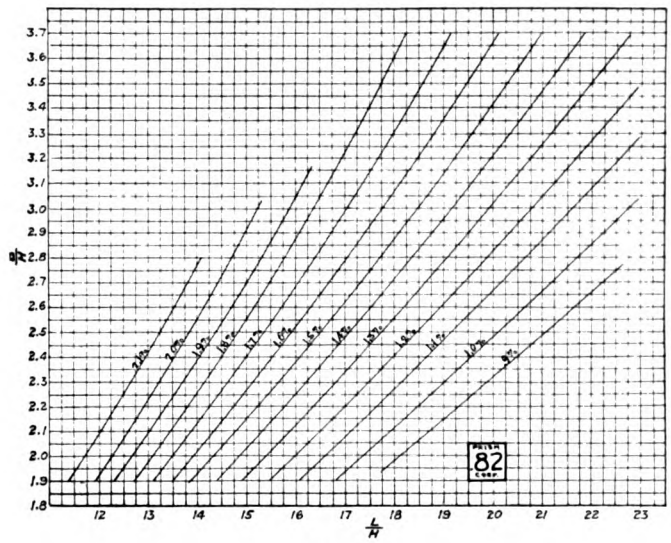

Fig. 9

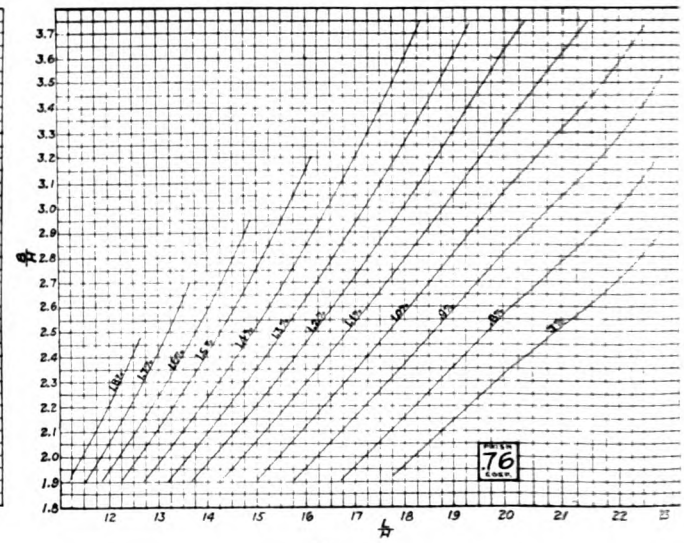

Fig. 12

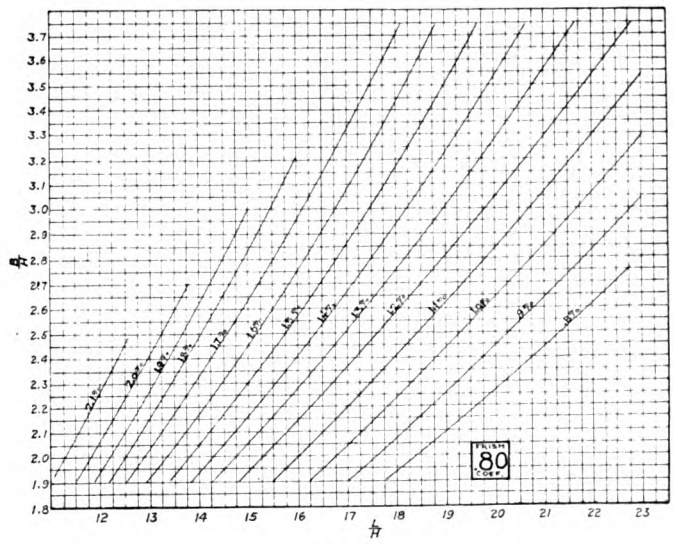

Fig. 10

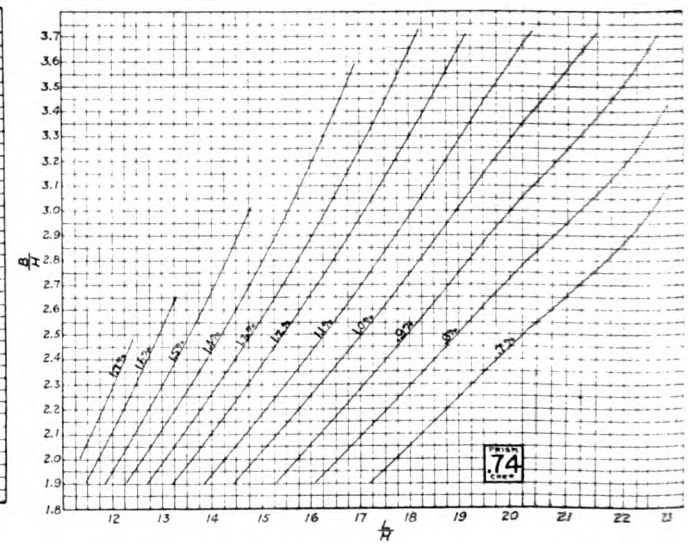

Fig. 13

Figs. 8 to 13, Inclusive, Show the Correction Factor of Obliquity or Values for f in $WS = G \times L \times (1 + \frac{f}{100})$

f = factor of obliquity, WS = molded wetted surface, L = length between perpendiculars, G = molded mean girth.

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plete investigation of the subject for one particular type. Published articles on the subject of wetted surface are erally an attempt to devise a formula or method to cover types of vessels, with the attending result that the acacy on particular types of vessels is thereby impaired. e larger number of vessels with which we have to deal of the merchant type of comparatively full form, and it peared desirable to confine the investigation to that type vessel.

In engineering, a simple formula, if theoretically correct, l give accurate results provided the proper coefficients available, and the less complicated the formula the easier d more quickly are the calculations made and with a ser liability of error.

Probably the best known and simplest formula for wetted face is "Taylor's formula" in the form of

$$W.\ S. = C \times \sqrt{D \times L}$$

ere $W.S.$ is the wetted surface, D the displacement, L the gth, and C a suitable coefficient. For its simplicity this m was accepted, and a complete investigation was made of l-formed vessels for all conditions of length, breadth, depth d block coefficient.

To obtain coefficients which are truly comparable with each ier, the calculations were made from a standardized series lines, characteristics of which are indicated in Table I and e transverse and profile shown in Figs. 1 and 2. In deloping the standardized lines, a study was made of all the rves of immersed areas of vessels for which model experients were available and also of Naval Constructor Mcatee's paper on model experiments of vessels with varying nounts of parallel middle body appearing in the transtions of this Society for the year 1919. These lines are t an attempt to determine the most efficient form for all nditions, but are intended to represent good practice of a rmal vessel having the maximum amount of parallel body ithout undue increase of the effective horsepower.

From these lines, for varying conditions of length, breadth, aft and block coefficient, the wetted surface was calcuted, treating the entrance, run and parallel body separately. he surface of the entrance and run were obtained by means a correction factor of obliquity derived by means of the tailed secant calculations described by Admiral Taylor his paper to this Society in the year 1898. Throughout ie calculations check methods were applied which showed early any error of a small fraction of one percent.

The results should therefore represent within a fraction of ne percent the wetted surface of a series of vessels having the rm described herein, and it is not believed that a material eparture of the curve of immersed areas or transverse staons would seriously affect the result.

In addition to the series curve for the value of C in Tayr's formula, there is included a set of series curves for the rrection factor of obliquity. The correction factor of obquity is the percent which must be added to the length when ultiplying the length by the mean girth to obtain the wetted rface.

In the formulas

$$W.\ S. = C \times \sqrt{D \times L}$$

$$\text{and } W.\ S. = G \times L \left(1 + \frac{f}{100}\right)$$

ne following nomenclatures are defined:

$W.\ S.$ is the molded wetted surface in square feet, propeller perture not deducted.

D is the molded displacement in tons of 2,240 pounds.

L is the length between perpendiculars, *i. e.*, from the forward ide of the stem to the after side of the rudder post at the load vaterline. This length is approximately one percent greater than he length of the load waterline faired into the centerline without reverse curve at the stern post.

B is the molded breadth.

H is the molded draft.

TABLE I.—CHARACTERISTICS OF STANDARDIZED LINES.

Length between perpendiculars = 1.						
Block coefficient on L/PPs	0.84	0.82	0.80	0.78	0.76	0.74
Mid section coefficient....	0.985	0.985	0.985	0.985	0.985	0.985
Pris. or long. coefficient..	.8528	.8325	.8122	.7919	.7716	.7513
Length of par. body.....	.5794	.5214	.4634	.4054	.3473	.2893
Length of entrance.....	.1687	.1947	.2213	.2482	.2757	.3037
Length of run.....	.2519	.2839	.3153	.3464	.3770	.4070
Long. coeff. forward body.	.8819	.8637	.8451	.8263	.8070	.7072
Long. coeff. after body...	.8237	.8013	.7793	.7575	.7361	.7152
Center of buoyancy forward for ½ L.....	.01380	.01457	.01520	.01570	.01602	.01609

G is the molded mean girth of transverse sections to the load waterline up to which the $W.\ S.$ is to be calculated.

f is the correction factor of obliquity.

The cut-away of the fore-foot is 47/100 of one percent of the longitudinal immersed plane.

The aperture for the propeller, amounting to about 1.3 percent of the immersed plane, is not deducted. In ordinary cases this may be assumed to compensate for the area of the rudder. In case the vessel has no aperture, allowance must be made for the rudder area.

Ship Displacing 15,900 Tons Lifted in 15,000-Ton Floating Dry Dock

USING a 15,000-ton drydock, Port of Portland, Ore., engineers recently accomplished the feat of lifting a large motorship, weighing 8,400 tons including bunkers, fully loaded with 7,500 tons of cargo. Surveyors were exceedingly skeptical, some of them declaring that the drydock would never stand the strain or that the vessel would

Loaded Vessel in Dry Dock

be damaged. One surveyor approved the plan of raising the vessel fully loaded and engineers went ahead.

The five-pontoon dry dock lifted the big motorship high and dry in a total pumping time of one and one-half hours. The vessel rested easily on the keel blocks and after the necessary plans were completed to permit plans for repairs to be drawn for stern frame and rudder, the ship was lowered. This was done because the necessity of removing keel blocks for repairs placed the motorship in danger of strain. After most of the cargo was removed, the motorship was again lifted and repairs went ahead.

The vessel is the Dutch motorship *Dinteldyk* of the Holland-America line. A faulty steering gear caused the vessel to strike her bow in the channel at Portland. The dry dock is 492 feet long, 94 feet wide between wings and the depth of water on keel blocks when submerged at low water is 27 feet. It is electrically operated by a remote control system.

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Reversing Systems of Large Marine Oil Engines

We have received many requests from seagoing engineers for the publication of articles on the practical operation of Diesel engines. The paper of which the following is an abstract was read recently in London before the Institute of Marine Engineers by Miss V. Holmes. While possibly more closely related to design than to operation, the descriptions and diagrams of the various types of reversing gears are admirably clear and we believe will be of interest to everyone connected with the operation of Diesel engines as well as those who are in search of information regarding this type of machinery.

SMALL marine internal combustion engines are usually designed to rotate in one direction only, and astern running is effected either by a reversible-blade propeller or a reversing rudder, or by reversing the direction of rotation of the propeller through gear wheels—none of which are suitable for large installations. Vessels driven by large marine oil engines were in early days reversed by what was known as the Del Proposto drive, that is, say, for ahead running the engine drove the propeller direct, but for astern running a dynamo coupled to the engine supplied current to a motor coupled to the propeller, so as to reverse the direction of rotation of the latter. This arrangement was heavy, costly, and occupied too much space, and the necessity for directly-reversible engines soon became apparent. To the Noble Company, then a Russian firm, belongs the honor of having produced the first directly-reversible marine oil engine in 1905. At the present time all medium-sized and large oil engines are made directly reversible, except in the comparatively rare cases where electric transmission is used.

The mechanism for reversing a large oil engine is far removed from the simplicity of that of a steam engine. The valve gear of a steam engine is merely concerned with admitting and exhausting one working fluid—steam, whereas oil-engine valves have not only to admit fuel and exhaust the products of combustion, but have also to admit air at different times and in several different forms—high-pressure blast air for injecting the fuel (in the majority of engines), high, or medium-pressure air for blowing the engine round during starting, and atmospheric or slightly compressed air to support combustion. It is, therefore, not surprising that a Diesel-engine reversing-gear should be considerably more complicated than, for example, a Stephenson link motion.

General Description

All the movements of engine parts required to change the direction of rotation from ahead to astern, or vice versâ, have to take place in a definite order, and can be grouped accordingly. In a typical system the operations take place as follows:

1. Stopping.—This is accomplished by cutting off the fuel supply either by the control of the fuel-pump suction valves, or by preventing the opening of the fuel valves, or some other means.

2. Reversing.—This consists in altering the setting of all valves in order that their timing shall be in correct relation to the cycle when rotation takes place in the opposite direction. On the majority of engines there are two sets of cams, one for ahead and one for astern running, and the valve-operating gear is brought under the influence of a different set when reversing takes place. The required movements are usually effected through the agency of a small reversing engine, operated by compressed air, as the endwise movement of the camshaft which is generally necessary, demands a considerable amount of force.

3. Starting.—This part of the mechanism brings into operation the starting-air valves, supplies compressed air to blow the engine round, and puts the fuel valves out of operation. When the engine has attained a sufficient speed to ensure firing, the starting-air valves are thrown out of operation and the fuel valves again function. It is usual to arrange the control of this part of the gear that fuel is admitted to some of the cylinders while the remainder still working on air, and only have fuel admitted when engine is well away. Thus, six-cylinder engines are sometimes divided into three groups of two for starting purposes.

4. Return to normal running.—This is obtained by speed-control lever or wheel, governing the supply of which was used to stop the engine before reversing.

Only Nos. 2 and 3 of the above—the reversing and starting parts of the mechanism—will be described in this paper.

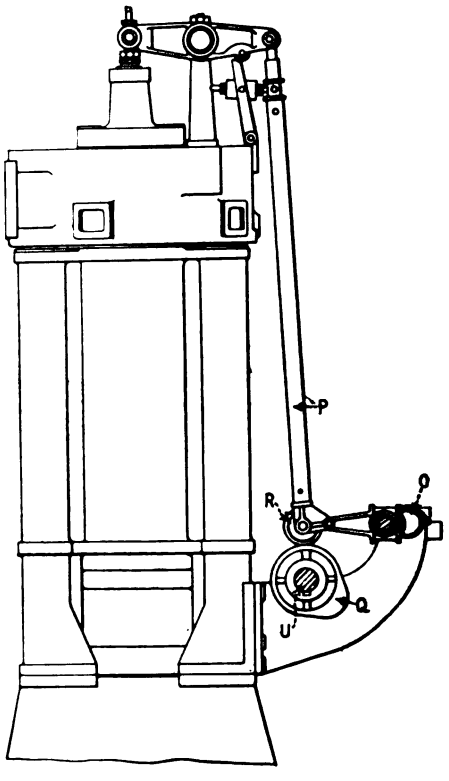

Fig. 1

as speed-control gear is a big subject in itself and would cause the discussion to be too much diffused.

There are two main problems confronting the designer; first, he must combine different motions so that they are executed in the right order by the movement of one lever or hand-wheel. For example, in the most common type of reversing-gear the rollers are lifted off the cams, the cam-shaft is slid endwise, and the rollers are lowered on to the second set of cams, all by the movement of a single lever. The second problem is to contrive that two sets of valve levers, those for fuel and air starting, are under the control both of the reversing lever and of the starting lever.

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Four-Stroke Reversing Systems

Burmeister and Wain System.—A typical example of a cessful four-stroke reversing-gear is that used on Burister and Wain engines. It belongs to the moving-camshaft e already referred to (Fig. 1). The rollers on the long sh-rods are coupled to a cranked reversing shaft O, which rotated, lifting the rollers off the cams before the camshaft moved longitudinally, and lowering them again when the ond set of cams is in position. The gear shown at the of the push-rods is fitted on exhaust valves only to keep

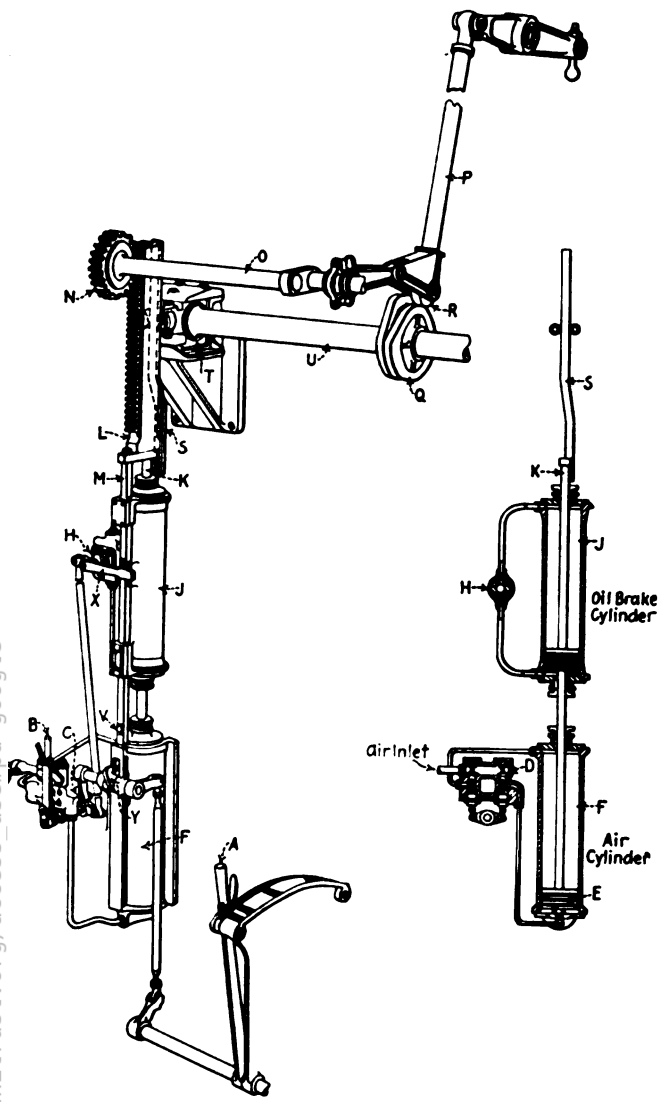

Fig. 2

iem slightly open during reversing. Suppose the order is iven to go astern, the engine is stopped by moving the naneuvering lever A to the stop position (Fig. 2). Until it s in this position the reversing lever B cannot be moved as is locked in the center position by the bolt C. The reversng lever is then moved to the left, opening the valve D, thus dmitting compressed air to the cylinder F, while the slide alve G makes communication between the top of the cylinder nd the atmosphere. At the same time the oil cock H conects the top and bottom of the oil-filled brake cylinder J. The air pressure moves the piston E upward and with it he piston-rod K, the rack L, and the bar M. The rack L urns the reversing shaft O through one complete revolution y means of the pinion N, thereby lifting the rollers R, which re coupled to O, clear of the cams, and returning them to heir original position. Meanwhile the guide S, which s cast on the back of the rack, moves the bearing T sideways, and with it the camshaft U, which has a collar on each side of the bearing; the stern cams are thus brought into position under the rollers before the latter are lowered on to them. The projection V on the bar M brings the handle B back into the central position by means of the lever X, thereby cutting off air from the servo-motor and closing the oil cock H.

It is only when these operations are completed that the maneuvering lever A can be operated, since it can only move when the bent lever Y is fitted into one of two holes in the bar M. Both starting and speed control are combined in the maneuvering lever. Fig. 3 shows the connection between the lever and the fuel pump. The gear is shown in the stop position, and consequently the eccentric fulcrum of the lever Z is in such a position that no fuel is delivered by the pump. It continues inoperative while the lever passes through the starting position, so that although the fuel valves open, no fuel is admitted. The starting-air valves are put into operation by small air cylinders on the top of the valves; when compressed air is admitted to these cylinders, the push-rods and rollers are pushed down on to the cams. When the maneuvering lever is moved past the starting position the air is cut off and fuel is again delivered by the fuel pump.

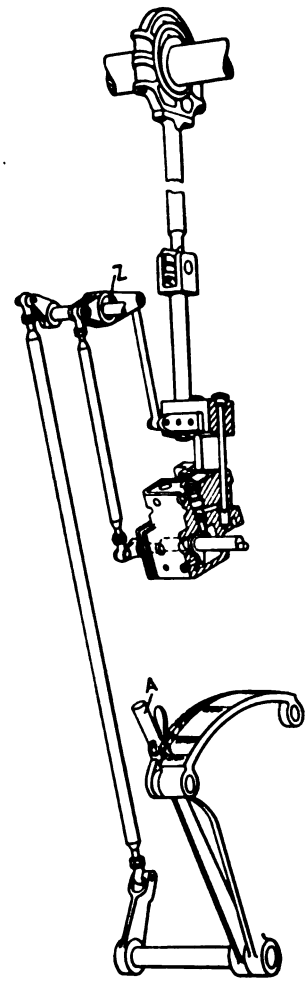

Fig. 3

The Werkspoor System.—The Werkspoor engine has many unusual features, and its system of reversing is unlike that of any other engine. Ahead and astern cams are provided, but the camshaft does not alter its position. The rollers are moved off one set of cams and brought into contact with the other set by a very ingenious method shown in Fig 4. The rocking-levers which operate the valves are mounted eccentrically on the rocking-lever shaft, and the axes of the eccentrics on which they are mounted are at an angle to the axis

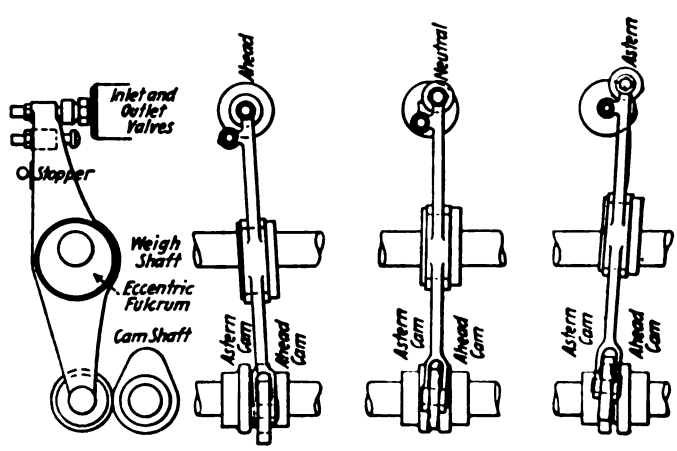

Fig. 4

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of the shaft. When it is desired to reverse the engine this shaft is rotated through 180 degrees; the effect of this is first to raise the rollers off the cams, and then to bring them down on the other set of cams, the longitudinal distance traveled being equal to the distance between the ahead and astern cams. It is so arranged that for ahead running the axes of the rollers are parallel with the axis of the camshaft, but for astern running they are slightly askew. As comparatively little astern running is necessary, the effect of this is negligible.

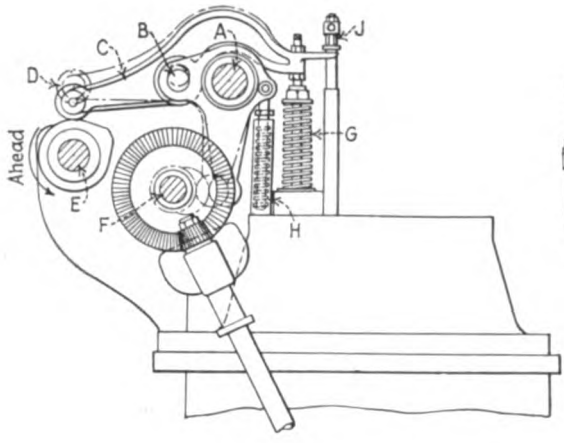

Fig. 6

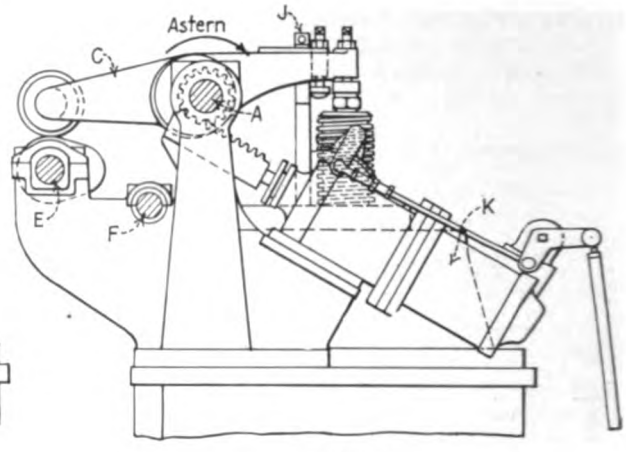

Fig. 5

The rotation of the rocking-lever shaft is effected by the movement of a small lever which admits air to the servo-motor (Fig. 5). The piston rod of the servo-motor ends in a rack which engages with a gear-wheel on the rocking-lever shaft, which is thus rotated through the desired angle.

The valves controlled by the method just described are the inlet, exhaust and air-starting valves, but not the fuel valve. There is only one cam for this valve, and though the lever is eccentrically mounted on the same shaft as the other levers, the effect of turning the shaft is merely to bring the roller into a different position along the periphery of the cam; since the eccentric is not set askew, there is no sideways motion.

The starting control is a hand-wheel, Fig. 7, which turns the starting shaft by means of bevel gearing. This shaft has cams on it and these cams move bell-crank levers mounted on the rocking-lever shaft (Fig. 6), thereby altering the position of the starting-air lever fulcrum. Unlike the other rocking-levers this lever is not fulcrumed on the rocking-lever shaft, but on the bell-cranked lever. The cam on the starting shaft lowers this fulcrum, and so brings the roller against the starting-air cam, and the valve into operation. Meantime, fuel is cut off by a double shut-off valve in the fuel and blast-air line, before the fuel valves, and actuated from the starting shaft.

The cams on the starting shaft are of different profiles, so that further rotation of the starting shaft puts three of the starting valves out of operation, and admits fuel to these cylinders. A further turn puts all cylinders on fuel.

An ingenious feature of this engine is that the reversing mechanism is interlocked with the telegraph, and if the correct reply has been given to the bridge the engines cannot be made to operate in the wrong direction.

Other Four-Stroke Systems.—Space does not admit of a description of many reversing systems in detail, but the more interesting features of certain other four-stroke engines may be mentioned. For instance, in the Beardmore-Tosi engine, the camshaft is not moved for reversing, but the rollers are moved by means of arms on a light shaft which is moved longitudinally, the forks of the rocking-lever being sufficiently wide to allow of this movement of the rollers (Fig. 8). Other interesting features of this engine are that the movement of the gear is effected by electrical means instead of by the ... compressed-air motor, and that only two levers are used ... stopping, reversing, starting and speed-control. Lever ... starts the electric motor C by means of the starter B, ... turns the fulcrum-shaft D on which the valve levers are ...

trically mounted. The diagram shows the sequence of operations which the rotation of this shaft effects. The gear ... connected by means not shown with the fuel pump and ... with the starting-air supply. Lever A moves the light reversing shaft which controls the position of the rollers.

The Vickers' reversing-gear is of the moving camshaft type, but the air-starting valve arrangement is unusual for a four-stroke engine. It consists of a simple non-return valve in the cylinder cover and mechanically-operated distributing valves which control the admission of air to the different ...

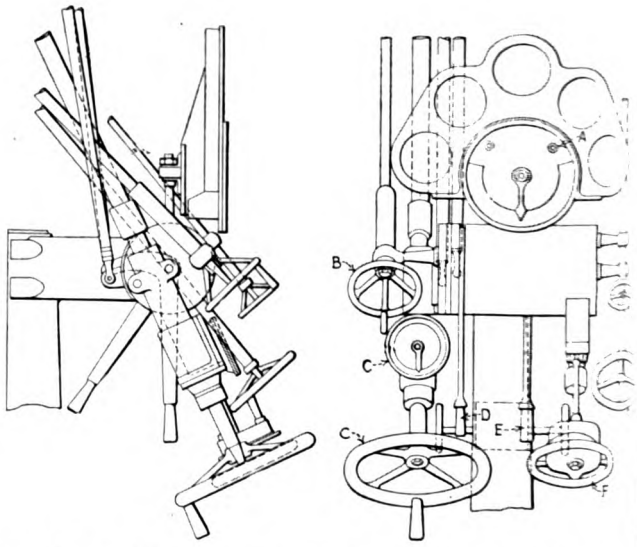

Fig. 7.—A—Telegraph, B—Air Suction to Main Compressor, C—Starting Gear, D—Reversing Engine, E—Telegraph, F—Fuel Valve, G—Maneuvering Air to Main Engines, H—Air to Reversing Engine

cylinders. On starting, the engine passes direct from ... cylinders on air to all on fuel, a considerable simplification of the gear being thus effected.

On the North British Diesel Company's large four-stroke engines, instead of the rollers being lifted, the camshaft is lowered till all cams are clear of the rollers and then moved endwise and raised again. The air-starting valves are brought into operation by means of small air cylinders; only

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hen compressed air is admitted to these cylinders do the llers come into contact with the cams.

Two-Stroke Reversing Systems

It is often claimed as one of the chief advantages of the o-stroke engine that reversing is much simpler than in the

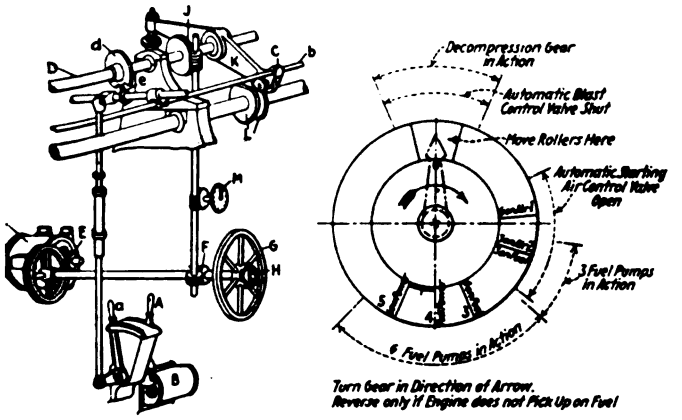
Decompression Gear in Action
Automatic Blast Control Valve Shut
Move Rollers Here
Automatic Starting Air Control Valve Open
3 Fuel Pumps in Action
6 Fuel Pumps in Action
Turn Gear in Direction of Arrow. Reverse only if Engine does not Pick Up on Fuel

Fig. 8

ase of a four-stroke engine. This is certainly the case with maller engines employing simple port scavenging and crank-ase compression, the direction of rotation of which can be eversed simply by an early injection of a charge of fuel, ollowing on the slowing down of the engine. With large ngines, however, the reversing-gear is, as a rule, little, if ny, simpler than that of a four-stroke engine, and the in-reased popularity of the two-stroke type for marine work epends on other advantages.

The Sulzer System.—The reversing-gear of the Sulzer

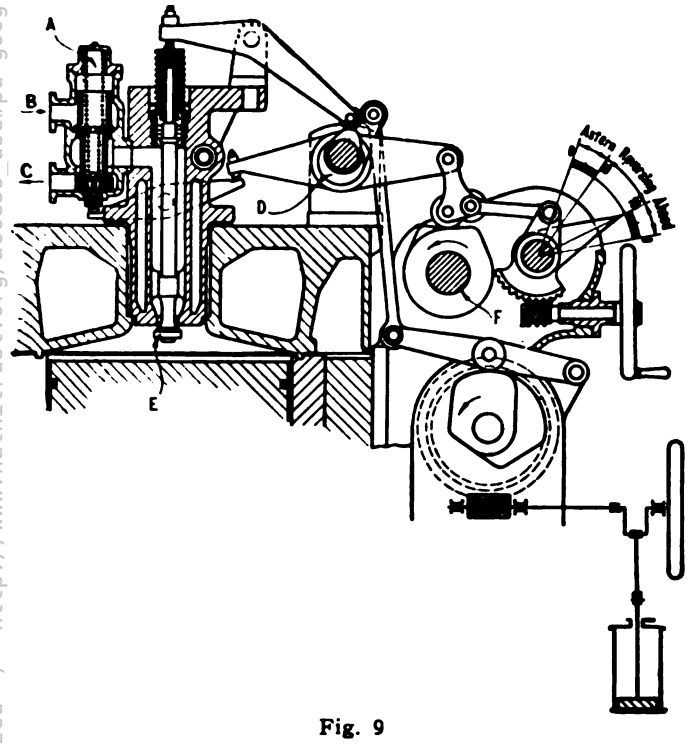

Fig. 9

engine is probably as simple as that on any large two-stroke engine. The upper row of scavenge ports is controlled by a horizontal rotary valve, the spindle of which runs the length of the engine. On the latest type scavenge air is supplied by an externally-driven turbo-compressor, so that the only valves of which the setting requires to be readjusted are the fuel, air-starting and scavenging-control valves. Sufficient play is allowed in the drive of the scavenge-valve spindle to readjust the timing of the valve when the direction of rotation is reversed, so that it is only the valves in the cylinder head which require special reversing-gear. These have the usual side-by-side ahead and astern cams, but no movement of the camshaft is necessary to reverse the engine. Each rocking-lever is operated by a link carrying two rollers (Fig. 9). These rollers are longitudinally displaced so as to be over their respective cams, and are also a certain distance apart in a transverse direction. By turning a cranked reversing-shaft which is connected to the roller link, one roller is removed from, say, the ahead cam, and the other is brought down on to the astern cam.

The control of the fuel valve by this means is quite simple,

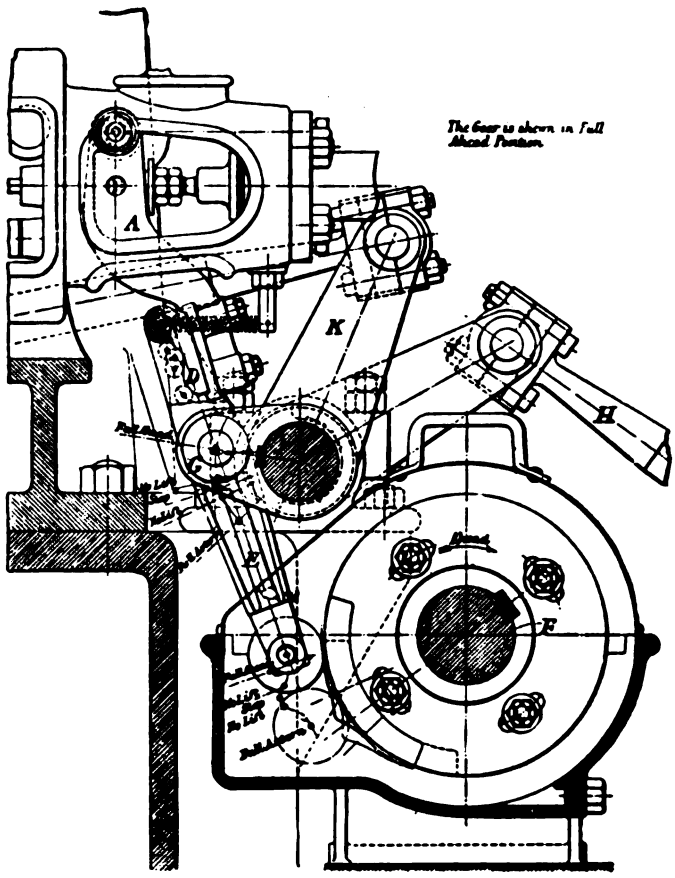

Fig. 10

but the air-starting valve gear is more complicated (Fig. 9). There are in fact two air-starting valves, the main valve communicating with the cylinder, and the advance valve in a passage which leads up to the main valve. The former remains open during starting, while the latter opens and closes in accordance with a cam on the camshaft. Both these valves are under the influence of the control shaft D, which is turned by hand or by a servo-motor in a manner which is made obvious in Fig. 9. A cam on the control shaft holds the main valve open by means of a rocking-lever, and owing to the lever of the advance valve being eccentrically mounted on the control shaft, it is only brought into operation when the control shaft is in the starting position. The fuel-valve lever is also eccentrically mounted on the control shaft in such a manner that it is out of action when the starting valves are operating.

The action of the advance starting valve is interesting. A small spring-loaded valve within the advance valve is first opened by the rocking-lever, thereby relieving the pressure on the valve. Further movement raises the whole advance valve and cuts off communication between the cylinder and

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the scavenge trunk, and still further movement connects the starting-air supply with the cylinder. As the valve descends again starting-air is cut off and communication is opened between the cylinder and scavenge trunk. The valve thus acts as a decompression valve as well as a starting valve, and the starting-air instead of being wasted goes to supplement the scavenge air.

The Doxford System.—The Doxford opposed-piston engine uses mechanical injection of fuel, and the method of reversal is bound up with the very original method of fuel-valve operation and control (Fig. 10). A rocking-lever has a roller at each end; one roller is in contact with the fuel cam D and the other with the cam-plate on the valve-operating lever. The position of the fulcrum of the rocking-lever is controlled by hand. If the gear is in full ahead position the lowering of the fulcrum reduces the lift of the fuel valve till the stop position is reached. Further lowering of the fulcrum brings the rocking-lever into the correct position for astern running. Naturally the lever is not moved beyond the stop position till after the engine has been started in the reverse direction by starting-air.

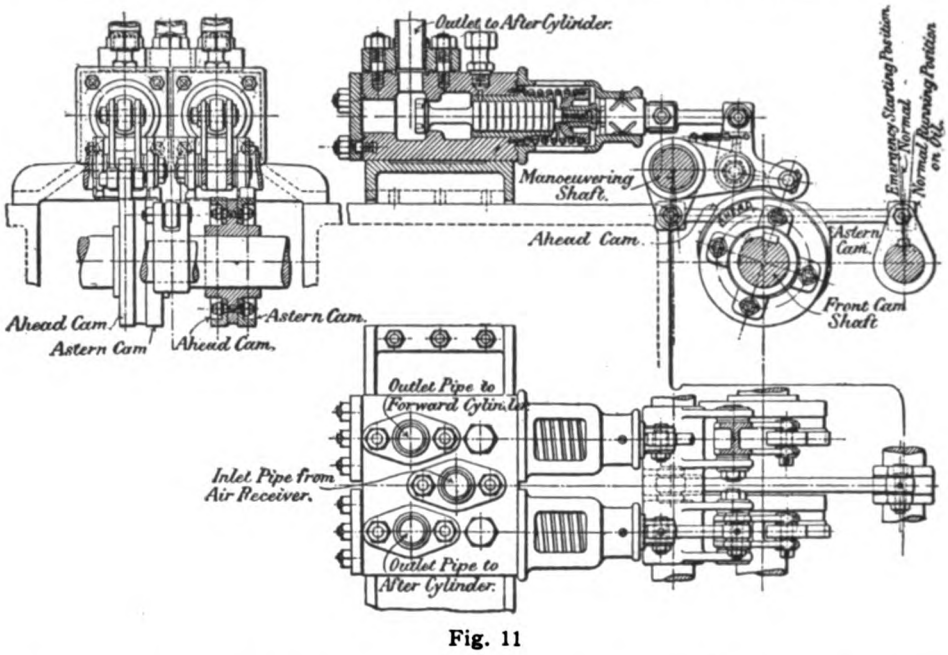

Fig. 11

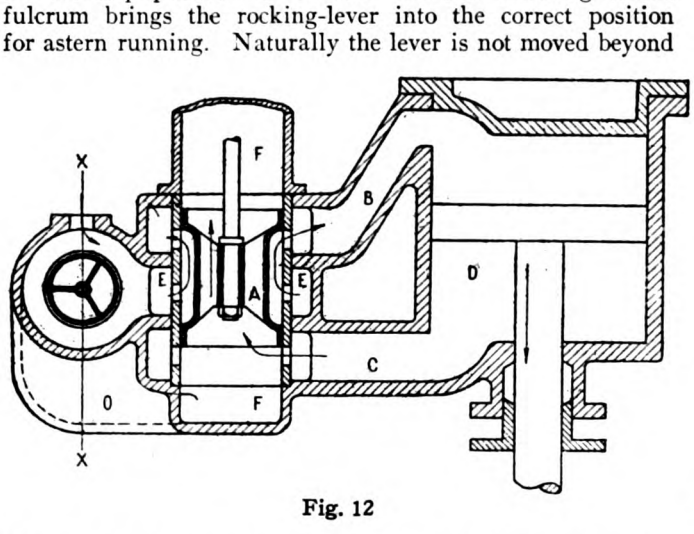

Fig. 12

For the admission of starting-air (Fig. 11) there are ahead and astern cams for each cylinder and these can be slid along the camshaft to bring the desired cams into operation. These cams operate the valves through bell-crank levers; by raising the fulcrum of these levers the starting-air valves are put out of operation. These valves do not deliver air direct to the cylinder, but the air passes into it by way of a non-return valve. This arrangement has the same advantage as in the Vickers and Sulzer systems in that the really important part, the starting valve is out of contact with the hot gases, and so no leakage cannot take place.

The whole operation of reversing is effected by hand. Suppose the engine is running ahead and the order is given to go astern. A large hand-wheel brings the fuel-valve gear to the stop position and simultaneously a small hand-wheel is turned to reduce the pressure in the fuel pumps. Next a lever is pushed forward bringing the astern and starting cams into position. The small lever is then moved forward, the result being to bring a roller on the maneuvering wheel into play so that when this wheel is turned it performs, temporarily, a double function; it becomes both the starting control and the speed control. The first turn brings the air-starting rollers down on to their cams, a further movement brings the fuel-valve gear again into operation and lifts the starting-valve levers out of operation. The roller brought into operation by the small lever falls automatically out of action, and the large hand-wheel becomes purely a speed control once more.

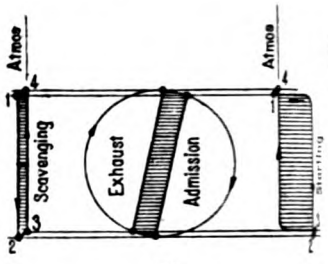

Fig. 13

Other 2-Stroke Systems.—The Neptune 2-stroke engine, built by Swan Hunter and Wigham Richardson, Ltd., and the Polar Diesel engine, from which the Neptune was originally derived, both have scavenging cylinders below the main cylinders which, during normal running are used for compressing scavenge air. It is into these scavenge cylinders that compressed air is admitted during starting. This arrangement means that only one valve is required in the cylinder cover—the fuel valve. Another advantage is that the cold starting-air does not come in contact with hot surfaces of the combustion chamber.

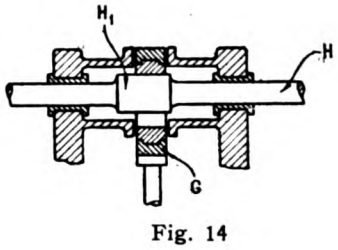

Fig. 14

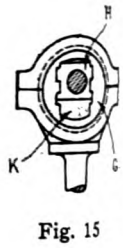

Fig. 15

On the Neptune engine the ports of the scavenging cylinders are controlled by a vertical piston valve as shown in Fig. 15. E is a central admission chamber and F is the scavenge-air receiver. During normal running E is connected with the atmosphere, air enters the appropriate port of the scavenging cylinder according to the position of the piston valve, while the other port is discharging to the air receiver. Fig. 15 is a valve diagram showing that both ports are closed between

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ints 4 and 1 of crankshaft rotation and also between 2 and just after deadcenter. Pressure diagrams for scavenging d starting are shown on either side.

Though Fig. 12 shows a double-acting scavenge pump, the tual arrangement consists of two single-acting scavenge linders at 180 degrees, controlled by one piston valve. This alve is driven by an eccentric on the camshaft. The method readjusting the timing of the valve for reversal is shown Figs. 14 and 15. The eccentric G is mounted on the amshaft H and held by inclined ridges H, so that when the amshaft is moved axially the eccentric is obliged to slide

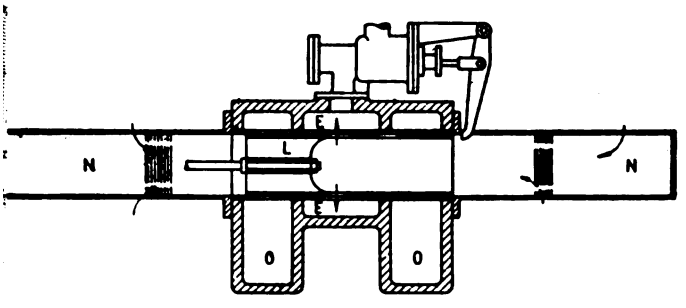

Fig. 16

o the desired angle. When the engine is to be started on air, the change-over valves L are moved, so that instead of he suction connecting with the intakes N from the atmosphere, as in Fig. 16, it is connected with the starting-air supply, the valve of which is opened by the movement of the change-over valve, as shown in Fig. 17, the delivery might be

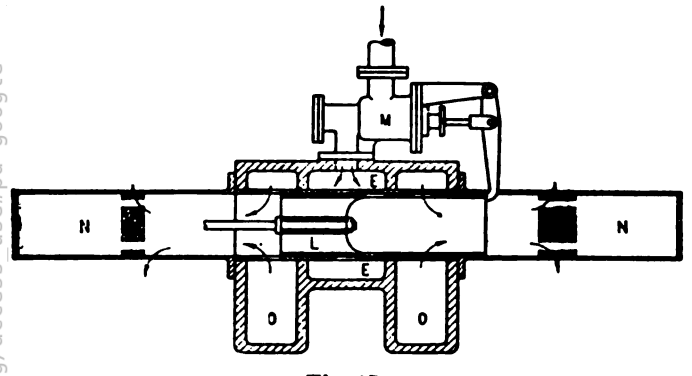

Fig. 17

used to raise the scavenge-air pressure, but to avoid back-pressure most of the air is exhausted into the atmosphere at N, by means of the passages O connecting the change-over valve to the scavenge air receiver.

The Scott-Still combined oil and steam engine uses mechanical injection of the automatic fuel-valve type, and so only requires to reverse the fuel-pump operating gear (for which ahead and astern cams are provided) and the steam-distributing valves. Naturally, on this engine steam takes the place of compressed air for starting purposes. During starting, steam is admitted with a later cut-off than during normal running. Both the reversing mechanism and the steam valves are hydraulically operated, oil at 400 pounds per square inch pressure being used.

Some Considerations in the Design of Reversing Systems

The foregoing is far from being a complete review of the methods of reversing large oil engines, but it will serve to give some idea of the variety and ingenuity of reversing systems. It will no doubt be a long time before one standard type of reversing-gear is used to the exclusion of other types, if, indeed, this is ever the case.

On all such problems it is the sea-going engineer who says the last word, and not unnaturally what he demands above all else in maneuvering gear is reliability and simplicity.

It is difficult to see how the construction of a four-stroke reversing-gear can be greatly simplified, but it seems as if two-stroke designers might take advantage of the inherent simplicity of those engines to produce a simpler reversing system than any in use at present. For instance, if distributing boxes were used for starting-air, in conjunction with fixed valves or non-return valves in the cylinder head, the only cams on the camshaft would be the fuel valves. Provided that the fuel-valve design allowed the use of symmetrical cams, reversing could be effected by resetting the camshaft relative to the crankshaft.

Interlocking Gear.—No description has been given of interlocking devices, but the design of these does not as a rule require any great ingenuity. They are usually necessary to prevent the reversing lever being moved until the fuel has been cut off, and to prevent starting-air being admitted unless the reversing lever is in either the ahead or astern position. Frequently the speed-control, reversing and starting mechanisms reduce down to parallel shafts in the neighborhood of the controls, and in such cases it is usual to provide, on a pair of these shafts, disks of which the combined radii are greater than the distance between the shafts; a bight out of each of these disks allows the other to turn, but only when the stationary one is in a certain position.

Position of Controls.—The ideal position for the controls is a point on which marine engineers are not agreed. At one time the engine was always controlled from the bottom platform, and this is still the usual arrangement. Recently, however, some engines have been built with controls at the top platform level, and this arrangement has certain advantages, the principal one being that the external moving parts of the engine are under the eye of the engineer on watch.

Starting-Air Supply.—An important point not yet touched upon is the supply of starting air. The designer has to decide on the capacity of three sources, the starting-air receiver, the main compressor driven by the engine and the separately-driven auxiliary compressor. According to the requirements of Lloyd's, twelve successive reversals must be made without bringing any auxiliary compressing plant into use. This is clearly a question of receiver capacity. A large receiver gives the advantage that a number of starts at short intervals can be made without starting the auxiliary compressor.

The chief function of the main compressor is, of course, to supply blast air, but its capacity is in excess of what is required for this purpose, and the surplus goes to recharge the starting-air receiver. For long periods while the ship is in open waters no starting air is required, and the surplus air becomes a problem. On the other hand, as much air as possible is desirable, as the engineer naturally wants to avoid starting up the auxiliary compressing plant if possible.

Economy of starting air depends chiefly on the pilot and on the engineer on watch, but it is aided by good engine balance and, in two-stroke engines, by the provision of decompression valves. A very heavy flywheel which is of great advantage for slow running is a disadvantage when it is a question of stopping rapidly or starting. For every type of engine there is a pressure at which the economy of air is greatest, usually in the neighborhood of 300 pounds per square inch, and means must be provided to reduce the air to this pressure from the storage pressure.

These are a few of the problems that are bound to crop up in the design of any oil-engine reversing-gear, the majority, however, will be ones peculiar to the engine or the reversing system concerned. The great diversity that exists in the present day in oil engines, and more especially in their systems of reversing, makes generalization difficult.

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Instruction for Students of Oil Burning

Practical Course Offered at Todd Free School for Marine Engineers, Firemen, Oilers and Watertenders

By A. Leonard Wernert*

MEN in charge of the operation of oil-burning equipment realize that the burning of fuel oil efficiently and economically is a science and not merely the opening and closing of a valve. Efficiency and economy in operating depends considerably on intelligent handling of the equipment.

In order to train men in this comparatively new science of oil burning and to obtain the best results from operation, the Todd Shipyards Corporation established at the plant of the Todd Oil Burner and Engineering Corporation, 742 East 12th street, New York, a free school for the instruction of engineers, oilers, water tenders, firemen, both stationary and marine; in fact, anyone interested in oil burning.

This instruction has been arranged in the belief that it will reduce fuel consumption, insure efficiency in the handling of oil-burning equipment, and insure operation costs. It is our aim to make the course as practical as possible, with sufficient theory to make it interesting.

The course commenced on August 1, 1923, with a class of twelve men. At the present writing, 350 men have applied to take the course. Three hundred and twenty-five men have completed the course satisfactorily and have received their certificates.

Questions and Answers

The following are some of the important questions that come up in each class, together with answers to each of the questions:

Question: How can I obtain efficient and economical results from my oil-burning equipment?

Answer: To obtain efficient and economical operation with any mechanical oil burner, three principal factors must receive special attention; they are—

1. Oil Pressure.
2. Oil Temperature.
3. Air Supply.

No installation employing mechanical atomization can be successfully operated unless the oil is delivered at constant uniform pressure and temperature at each burner, together with a constant and uniform supply of air. By carrying the oil pressure, oil temperature and air supply constant at each individual burner, we reach a balanced condition. Then, and only then, will each individual burner do the same amount of work.

Question: What is the proper oil pressure to carry at the burners?

Answer: Find out from the manufacturer of your particular type of burner the proper pressure to carry on your system, with their burner, in order to get good atomization. Once this pressure is determined, maintain it constantly regardless of load conditions.

Question: What size burner tips should be used?

Answer: The size tips to be used is determined by the oil pressure, which should be kept constant, and the boiler steam pressure which should also be kept constant. Should the steam pressure go up and the oil pressure come down, put in a smaller size tip. Should the steam pressure go down and the oil pressure go up, put in a larger size tip.

Question: What is the proper temperature to which the oil should be heated in order to get good atomization?

Answer: The proper temperature to which the oil should be heated in order to get good atomization is that temperature at the burners which will reduce the viscosity of the oil to 8 degrees on the Engler scale or 280 seconds on the Saybolt scale. In the past, and up to the present time, engineers have depended entirely too much on the gravity of an oil to determine the temperature necessary to obtain good atomization. Baumé gravity practically gives the engineer no information about the fuel oil except the weight. When an engineer determines the temperature by means of the gravity, he is only guessing at it. Oils of the same gravity but differing in viscosity, require different temperatures—the higher the viscosity, the higher the temperature necessary to atomize it properly.

A short while back I had occasion to test fuel oil from four different plants for their specifications. These four fuel oils had the same Baumé gravity—13 degrees Baumé at 60 degrees Fahrenheit. Two of the above-mentioned oils burned without much trouble, the third gave a little trouble, while the fourth, when sprayed onto a wood fire, put out the fire. This illustration is given to show why the gravity does not give the engineer any information about the fuel oil in regard to temperature. In the past, engineers usually determined the proper temperature at which to heat fuel oil by cutting and trying. When carrying too low a temperature on the fuel oil, the oil will not atomize properly, thus causing the burners to smoke heavily. No quantity of excess air will clear away the smoke from this cause, and the only remedy is to raise the temperature of the oil. When atomization is poor, it will cause a carbon deposit when the oil comes in contact with the heating surface before complete combustion takes place. With too high oil temperatures it is difficult to get the required amount of oil through the burners, as a high temperature increases the volume of oil and consequently decreases the weight of the oil passing to the furnace. In other words, keeping the oil pressure constant and gradually increasing the temperature, there is a point reached where the greatest amount of oil by weight will flow into the furnace. This is called the "critical point." Beyond this temperature continued heating of the oil increases the volume and actually results in decreasing the capacity of the burner. Excessive heating causes vibration of the boiler, and also tends to break down the oil in the pipe line and cause carbonization at the burner tips.

Authorities on mechanical oil burning, after years of practice and experience, have come to the conclusion that all fuel oils have about the same characteristics and can be burned with the same vane opening, air pressure or draft and oil pressures, when heated to that temperature which will reduce the viscosity to 280 seconds Saybolt. This is a decided advantage as a satisfactory method of operating, once determined for any given load, can thereafter be used, although different oil may be burned. Heating the oil above this temperature in no way improves the efficiency of evaporation and results in a direct waste of heat. This fact has been established by different authorities, and is the one most generally disregarded in practice.

Question: How can I cut down fuel consumption?

Answer: Although the oil may be delivered at a constant

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ssure and be finely atomized, it cannot be burned economically and completely unless the spray is mixed with air correct proportions. This mixture must enter the furnace form a perfect gas. The air must be delivered through e vanes of the register and must not enter the furnace in y other way. The vanes are adjustable so that it is possible to either increase or decrease the velocity of the entering air.

If insufficient air is supplied, combustion is incomplete, rming carbon monoxide (CO), reducing the furnace temrature, and preventing the heat units from being liberated om the fuel. It results in black smoke, carbon deposits . the heating surfaces and vibration. Too much excess air sults in lowering the evaporative efficiency of the boiler. more air is supplied than the carbon in the fuel can sorb, the excess is held in suspension and is absolutely no value and function, as it absorbs heat from the carbon at is being burned and detracts just that much from the at that would be given off to the boiler. A sign of excess r by observation of the stack is a clear stack or dense white noke.

If the proper amount of air is supplied, proper combustion obtained; that is, the highest percentage of carbon dioxide (CO_2) without any carbon monoxide (CO). The higher ie percentage of CO_2, the higher the furnace temperature nd the greater the number of heat units liberated. A light rownish gray haze at the top of the stack is a sign of good ombustion.

Many an engineer has said that he has no fuel oil losses; e has no ash pit loss; he loses none in the bilges; he umps none overboard; he makes no smoke, as he will point ut that the stack is perfectly clear, so where else does the eat go except into the steam? He realizes that some heat oes up the stack, that no one can prevent, hence he thinks ie is getting maximum efficiency. When questioned about tack temperature, carbon dioxide (CO_2), he claims his tack temperature cannot be much different from any other hip and further he has no stack thermometer to tell him vhat it really is, but CO_2, what is that?

Oil can be burned very economically with a high efficiency, or it can be burned wastefully with very poor efficiency. There are some installations in which no engineer is able o get anything like economical results, due to faulty design of furnace and burning equipment. In many cases, however, the fault can be traced to operating conditions where he men operating the plant either do not know the correct nethod of carrying their fires or are unconcerned whether good results are being secured or not.

In economical boiler practice, there are two kinds of efficiency; one known as combustion efficiency and the other as absorption efficiency. Combustion efficiency pertains to he proper burning of oil with the least amount of air to produce the greatest percentage of CO_2 without any significant amount of CO. To obtain such results, a flame of rich yellow color must fill the furnace without gaps or open spaces along the sides or underneath through which excess air may pass unconsumed. Absorption efficiency relates to the absorption of the heat by the water in the boiler. The stack thermometer is an indication of the absorption of the heat by the water in the boiler. The stack thermometer is an indicator of the absorption efficiency, and temperature should be logged from day to day, all changes noted and the cause of fluctuations investigated by the man in charge. Naturally the flue gas temperature will rise with dirty tubes inside and outside, and some engineers have the tubes blown every few days, whether they need it or not. Another cause of increased stack temperature is excess air. As this excess air is cut down, the flue temperature will drop in the same ratio. This is something that all engineers do not realize, and it is suggested that they make the experiment to convince themselves.

Outline of Course of Study

For the benefit of those who can take advantage of the opportunity offered by the free course in oil burning, the following is an outline of the course of study as given at the school:

The duration of the course is five days, Monday to Friday. The hours are 9 a. m. to 12 noon. Evening class, 7 p. m. to 9:30 p. m.

Monday—Class enrolls. Introductory talk by instructor. Tour of inspection of plant. Lecture on oil burning. Description of equipment.

Tuesday—Lecture on atomizers—steam, air, mechanical. Fuel oil-burning systems and burners. Lighting off burners on boiler.

Wednesday—Lecture on combustion. Description and use of draft gages, CO_2 apparatus, and stack thermometers. Demonstration in boiler room.

Thursday—Lecture on fuel oil and its properties. Laboratory demonstration of testing fuel oil for gravity, viscosity, flash point, burning point, water and sediment.

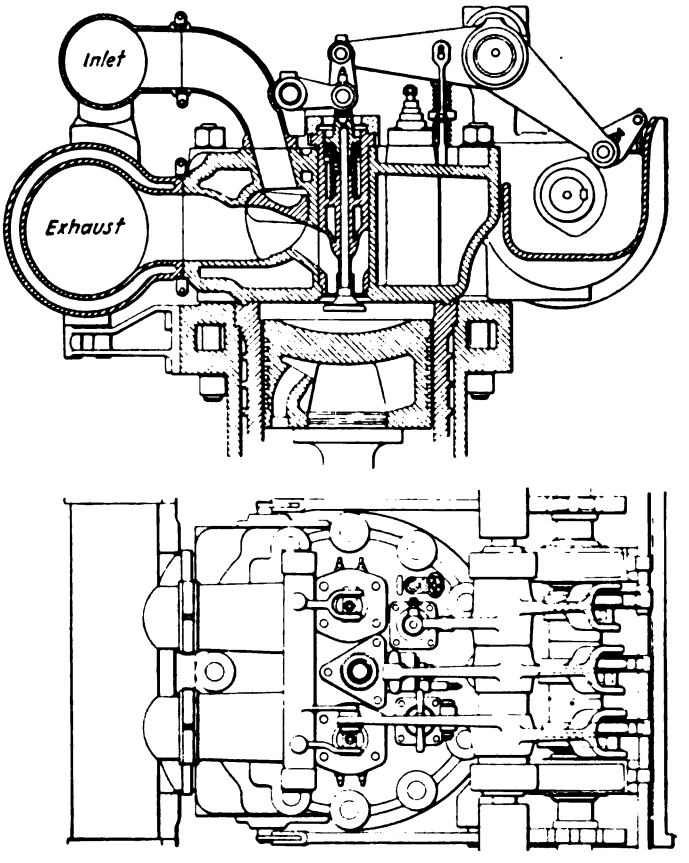
Friday—Lecture on care and operation. Review of course. Examination of student in boiler room.

The Tosi Diesel Engine

By Gian Carlo Ziliotto*

THE contribution which Italy has made to the development of the Diesel engine was most effectively set forth and recognized by Dr. Rudolph Diesel himself in the lectures given before American technical societies and institutions in April, 1912. Speaking of the early stages of the

*Naval architect, Lloyd Sabaudo, New York, and formerly Lieutenant, Construction Corps, Italian Navy.



Cylinder Head in Section and Plan, Showing Disposition of Valve Levers. Combined Inlet and Exhaust Valves Are Clearly Shown

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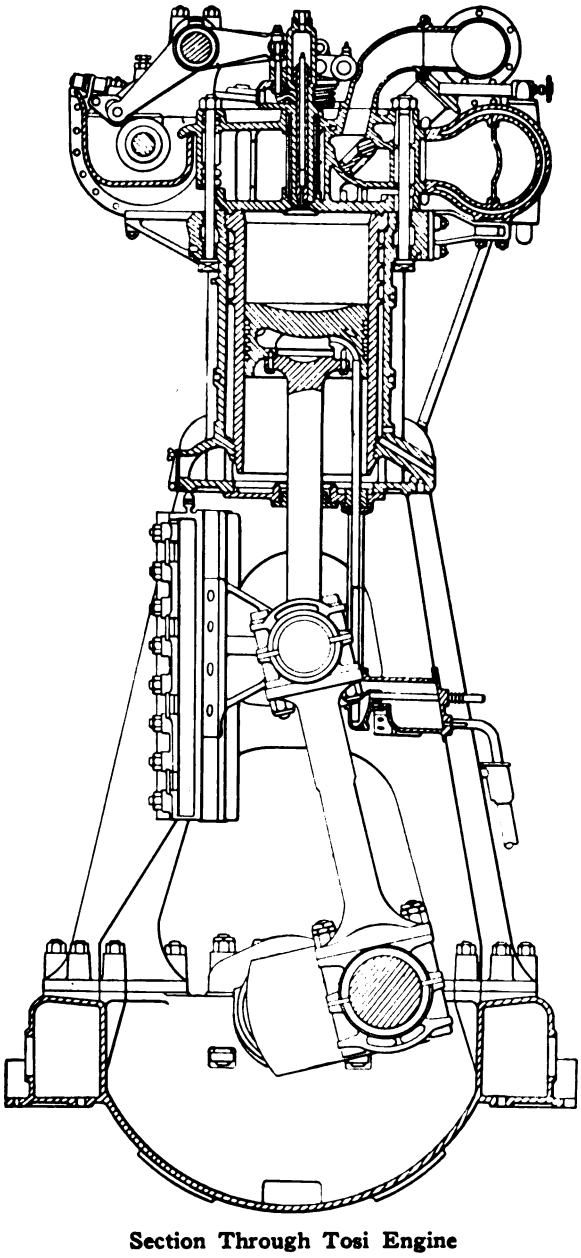
development of his engine Dr. Diesel not only mentions the Tosi firm as one of the pioneers in that field, but, to prove the superiority of his engine as compared with the most efficient steam engine, he cites the comparative tests between a Tosi-built Diesel engine and a Tosi-built steam turbine, which were run as early as 1911 at the exhibition of Turin.

The Tosi firm had been building steam engines for more than 30 years when it started, 15 years ago, to build Diesel engines, and so could put into the design and construction



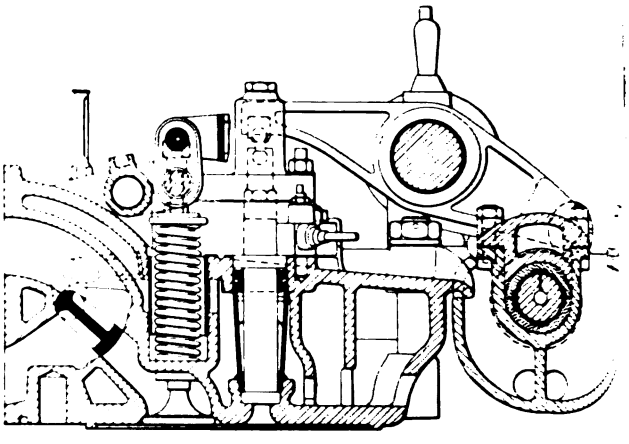
Section Through Tosi Engine

of the new engine the great experience of its staff of engineers and the proved skill of its workmen.

The peculiarity of the Italian situation as regards raw materials and man power is particularly suitable for the development of the Diesel engine, for perhaps no other nation has such lack of natural undersoil resources as coal, oil and iron as Italy, whereas she has a great surplus of skilled and unskilled workmen.

The field for the use of the Diesel engine is also large in Italy, where the cost of coal or fuel oil is great, due to the fact that every pound of it has to be imported and the freight haul added to the initial cost.

The Tosi firm has developed four different engines, each

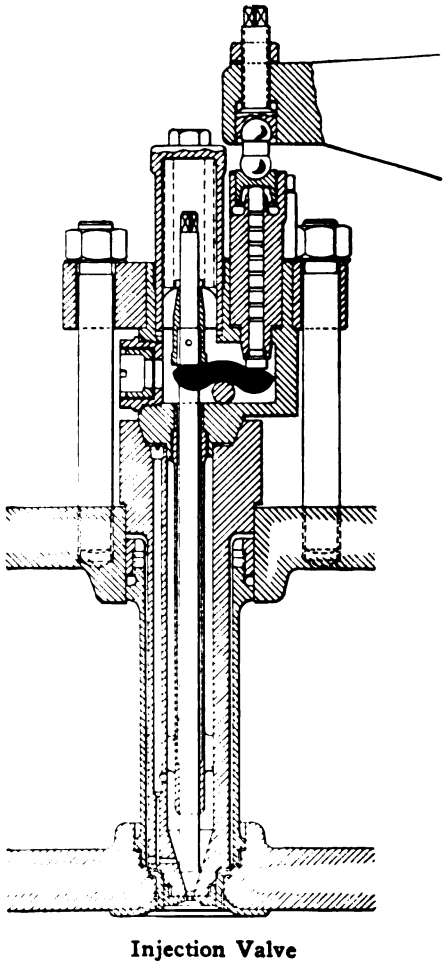


Special Distribution Valve

consisting of a variable number of similar cylinders, so with cylinders of only four different sizes it is possible obtain units ranging in power from 50 to 3,000 horsepo

For small powers the engine is built in units of 1 cylinders of 50 to 60 horsepower each, thus developing f 50 to 360 horsepower and for intermediate powers the gine consists of 4 to 8 cylinders of 100 to 125 horsepo each, developing from 400 to 1,000 horsepower.

The two engines differ not only in the size of the cylind but also in the general design, as the small one is of trunk piston type without piston water cooling and run a speed of 185 to 215 revolutions per minute, whereas intermediate power type is provided with marine cross guides and water cooled pistons and runs at a speed of to 185 revolutions per minute.



Injection Valve

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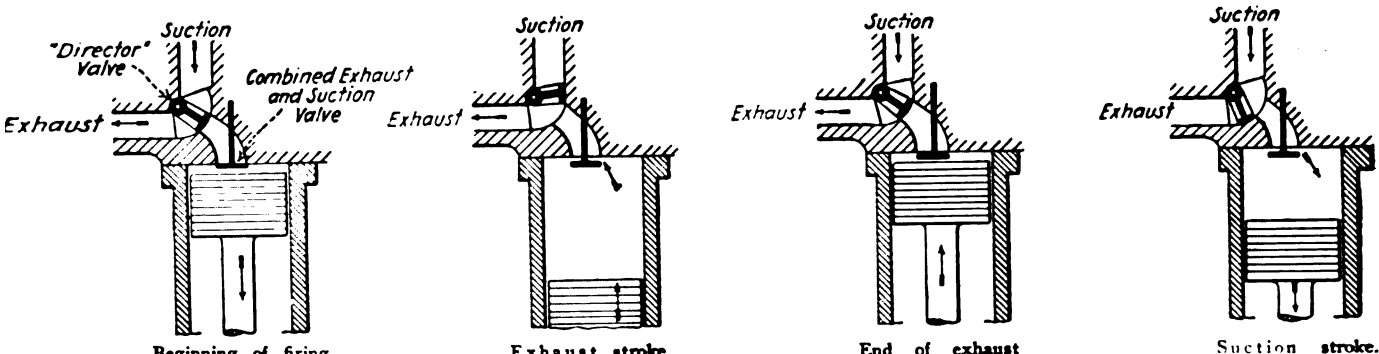


Diagrams Showing Action of Director Valve

The framing of the small engine up to 360 horsepower is of the enclosed crank case design of cast iron. In the intermediate type up to 1,000 horsepower the open type of frame is adopted with removable sheet iron doors.

For engines above 360 horsepower the piston cooling is effected through specially designed telescopic tubes in which the wear and tear are practically nil, as is the danger of water leaking into the crank case.

Forced lubrication is fitted in both types of engines by means of an oil pump of the spur gear type fitted at a low position in the crank case, eliminating any suction lift and thus securing continuity of action.

Provision is made to prevent the splashing of oil on to the trunk piston which is, in addition, provided with a scraper ring, and to prevent over-lubrication of the piston in the marine crosshead type engine.

The peculiar and most interesting features of the Tosi engines are, however, those relating to the distribution and injection valves which are of a patented design.

Combined Inlet and Exhaust Valves

Instead of having, as is usually the case, an inlet and an exhaust valve, the Tosi engines have incorporated a simple but very important modification, whereby both valves operating at the same time act alternately as the exhaust and remain open for the following stroke as the inlet.

In order to place the cylinder alternately in communication with the exhaust and with the induction manifolds an additional oscillating or "director," valve is provided in the cylinder head, driven by an eccentric on the cam shaft.

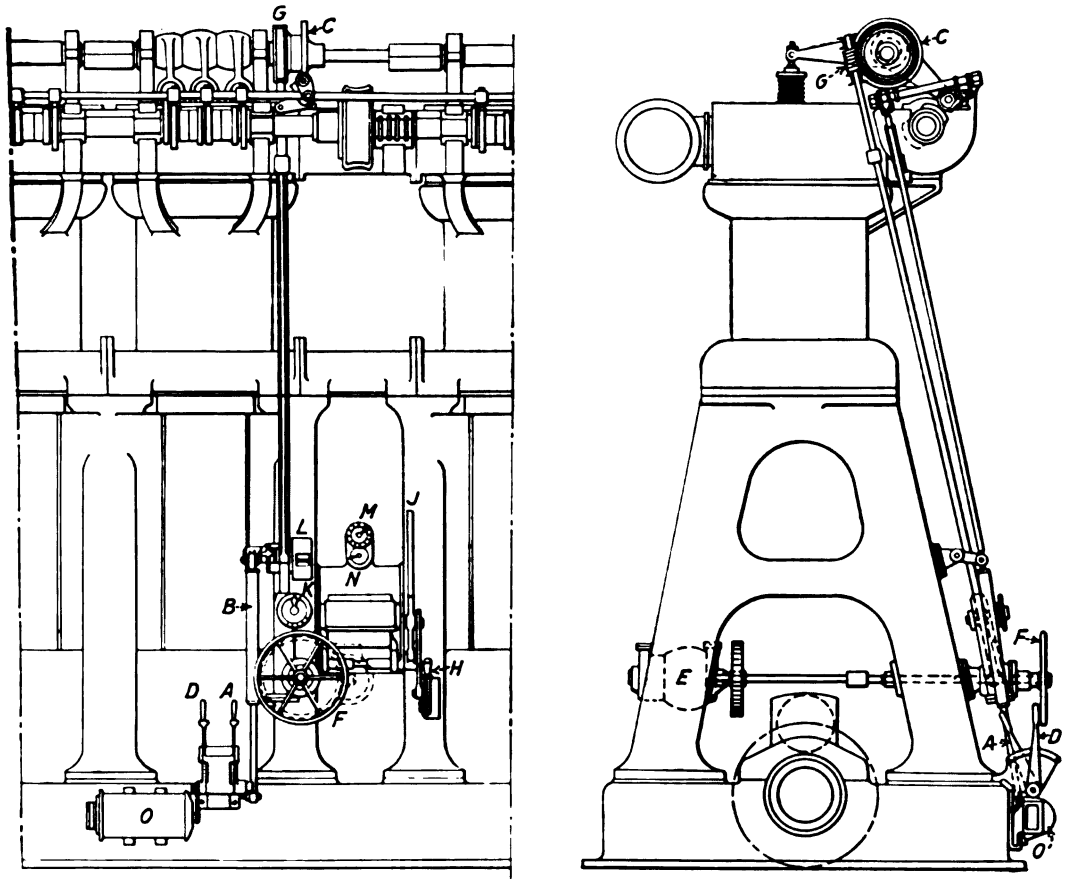
This arrangement overcomes the two weak points in Diesel engines of the four stroke type, viz.:

(1) The cracking of the cylinder head, which is liable to occur especially between the injection and exhaust valve pockets.

(2) The necessity of having frequently to dismantle the exhaust valve for cleaning and grinding in, say, after every 200 to 300 hours running, as is usual with the ordinary inlet and exhaust valves.

Cracking of the cylinder head usually occurs between the injection and exhaust valves (never between the injection and inlet) because this part, which is continually being subjected to the heat of combustion from exhaust, attains a very high mean temperature.

With the Tosi design, that part of the cylinder head adjacent to both valves is first heated by the exhaust gases during the exhaust stroke and afterwards cooled by the inlet air during the following suction stroke. This results in the mean



Arrangement of Reversing Gear

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temperature between each valve and the injection valve being considerably reduced, and materially lessens excessive stress in the cylinder head between the valve pockets and consequently any chance of cracking.

Another advantage is that, since the inlet air completely sweeps clean and cools each valve and its seat in turn before closing, the faces do not pit or distort, with the result that it is found in practice that dismantling, cleaning and grinding in of the valves only becomes necessary after from 3,000 to 4,000 hours running as against from 200 to 300 hours, as in the case with other designs.

It will thus be seen that it is not necessary to dismantle the cylinder heads and valve gear so often, which, in itself, is expensive both in time and money, aside from any consequential losses that may occur while the engine is not running.

The Injection Valve

Another exclusive detail of the Tosi engine is their patented injection valve, which entirely eliminates another weak point, viz., the gland for the valve spindle.

The valve is of the needle type entirely enclosed and operated through an internal lever pivoted on a fulcrum. The spindle that operates the valve is a small ground plunger, the bottom of which has a conical seat which acts as a valve. During the fuel injection period the main valve lever depresses the operating spindle and the valve face is removed for a short period from its seat, but it has been found that air leakage, which might take place while this valve is open, is effectively prevented by the ground plunger; and, should there be a slight leak, it is of small importance, considering that the time the valve is open is only that corresponding to an arc of 36 to 40 degrees in every two revolutions (720 degrees).

The advantages of this design are: (1) Certainty of action, ensuring correct timing, because the valve cannot remain open or become sluggish in action, as there is no gland to be tightened up too much or unevenly by the attendant, resulting in the spindle binding.

(2) The impossibility of loss of fuel through the gland, ensuring equal injection of fuel into each combustion chamber, and consequently an even loading of each cylinder.

Method of Cooling Cylinder

Another feature worth noticing is the spiral ridge on the outer surface of the cylinder liner about the combustion chamber. This insures a definite direction to the cooling water in the jacket at this section, and an even cooling of the liner is thus secured, where it is subjected to the greatest temperature.

The illustration also shows a light sheet steel manifold, placed immediately above the exhaust manifold and running the whole length of the engine; the air induction passages in each cylinder head are directly connected with this manifold. At each end of it a grid is fitted, and at its center is another pipe leading to a common chamber at the base of the cylinders. By means of this arrangement the space below the pistons is thoroughly scavenged and, should there be any blow past the piston rings, the gases do not pass into the engine room, but are drawn up into the induction manifold.

The air compressor is directly driven off the crank shaft and is of the three stage type, with "Hoerbiger" valves for the low and intermediate pressures, and cup valve for the high pressure. In the larger engine two delivery valves are provided for the high pressure. Between the various stages intercoolers are provided.

An interesting and successful innovation consists in the fact that the output is not regulated by exhausting excess air from the low pressure delivery and so restricting delivery to the third stage, but by choking the low-pressure suction, a better running of the complete installation thus resulting.

Usually for reversing purposes the cam shaft is move fore and aft so as to have the proper cams come under th valve levers: in the Tosi engine the rollers on the levers ar shifted in line with the proper cams, a light hand controll shaft being employed.

All the above features are incorporated in the marine an high power engines whose cylinders are of two sizes, viz.: o 200 and 400 horsepower, each unit consisting of 6 to 8 cylin ders and thus developing from 1,000 to 3,000 horsepower re spectively at a speed of 90 to 110 revolutions per minut and 105 to 125 revolutions per minute.

In the Richardsons-Westgarth-Tosi-type engine the orig nal Tosi design has been adhered to and few modification added; for instance, the clearance at the bottom of the cylin ders and in the crank chamber has been increased to affor better access to the top-end bearings, together with their bolts but thus increasing the height of the engine; the combine inlet and exhaust valves are carried in cages, instead of seat ing direct on faces machined in the heads, and a specia arrangement has been devised to allow for adjustments an expansion of said cages when the engine becomes warmed up

Another refinement instituted is that all the valves may b removed and replaced without dismantling the valve levers This has been achieved by fitting horse-shoe pieces on th lever shaft so that when removing them the lever can b shifted to clear the valve body.

(Photograph by Underwood & Underwood, N. Y.

First U. S. Vessel Equipped with Mooring Mast for Dirigibles

The *S.S. Patoka*, a converted tanker, at Norfolk Navy Yard, with "hitching post" for U. S. Navy dirigibles. Will be used if *Shenandoah* makes flight to Pole or other long voyage over the water.

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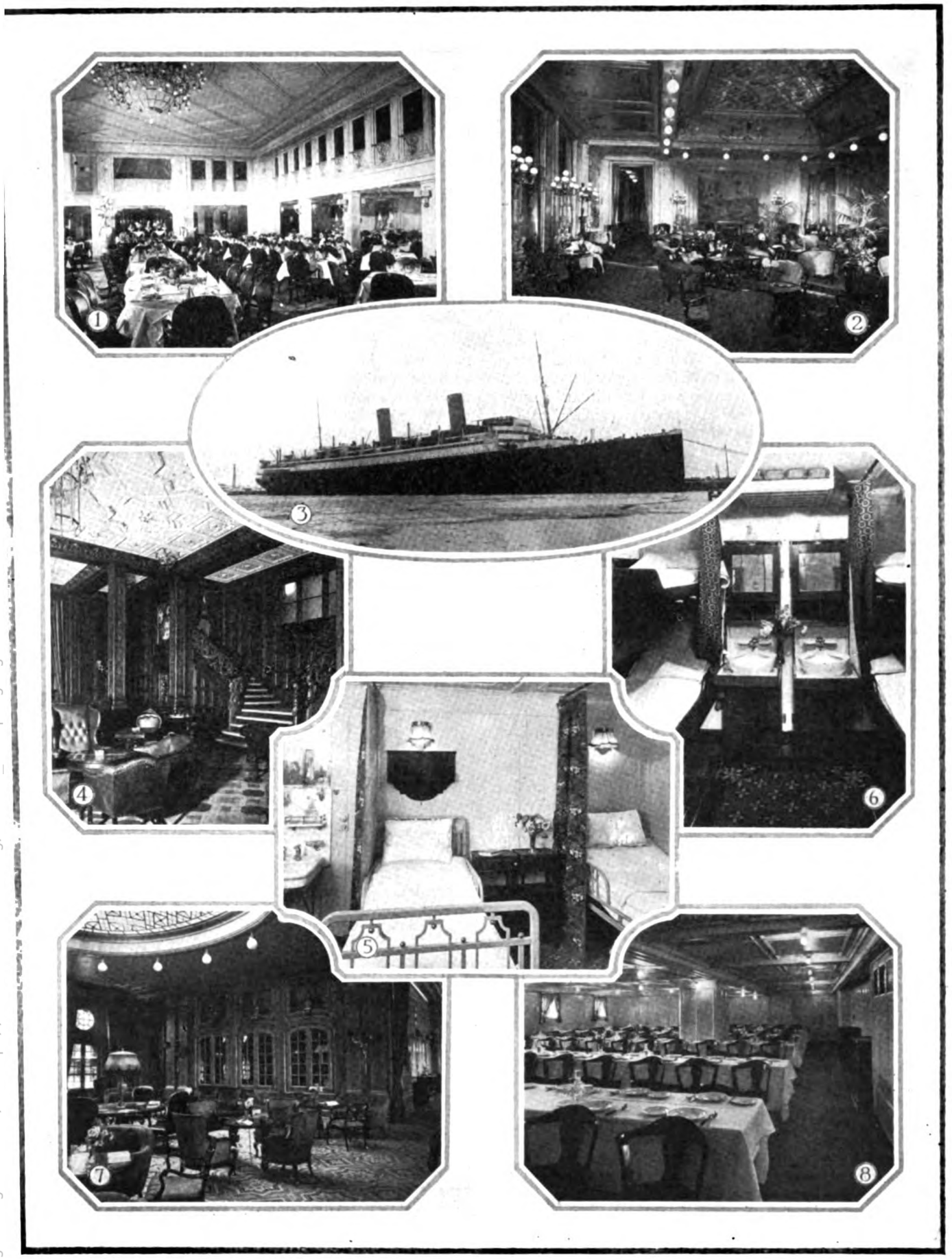

North German Lloyd Steamship Columbus: (1) First Class Dining Room, (2) First Class Social Hall, (3) The Columbus Ready for Her Maiden Voyage, (4) First Class Smoking Room, (5) First Class Cabin, (6) Third Class Cabin, (7) Library, (8) Third Class Dining Room

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A Deck Camber, Sheer and Bevel Nomogram

Method for Expressing the Mathematical Relation for Parabolic Camber in Nomographic Form—Its Application to Ship Joinery

By E. V. Telfer, M.Sc., A. M. I. N. A.

ALTHOUGH the number of alternative methods of constructing a beam camber curve are many, the purpose of the following notes is to show that there is room for one more in ship drawing office practice. The method proposed consists in expressing the mathematical relation for parabolic camber in nomographic form. This relation is usually expressed in the following form:

$$y = c\frac{x^2}{b^2}$$

where c is the midship camber, b the midship half-beam, and y the camber at any distance x from the centerline of the ship. This relation can be very expeditiously solved on an ordinary slide rule or on a special camber scale or slide rule well known to ship draftsmen. The nomographic presentation of the formula necessitates its being rearranged as follows:

$$\frac{y}{x^2} = \frac{c}{b^2} = k$$

The nomogram shown in Fig. 1 first of all solves the relation $c = kb^2$ by joining the midship half-beam and camber, the intersection with the ungraduated support scale represents the value of k^2. Since k is thus determined the same scales may be used to solve the relation $y = kx^2$ by joining x through the support intersection of $c - b$ to intersect the corresponding camber y. The manipulation of the nomogram is thus straightforward.

Determination of Sheer Heights

Not only, however, is the nomogram of use for cambers but it is directly applicable to the determination of sheer heights. In this case the half-beam scale serves the purpose of the half-length scale divided by ten, while the camber scale becomes the sheer height scale correspondingly divided by ten. The nomogram is used as before. The shear height on the fore perpendicular is joined to the half-length. The sheer at any other half-length is thus obtained by joining this half-length through the intersection of the previous basis line with the support scale to intersect the height scale at the desired value.

The principal advantage of the nomogram, however, is that by means of an additional scale it may be used to read off simultaneously with the camber the bevel or slope of the deck at any half-beam or distance from midships. The mathematical basis for this is very easily deduced. Thus since

$$y = c\frac{x^2}{b^2}$$

$$\therefore \quad \frac{dy}{dx} = \frac{2cx}{b^2} = \frac{2y}{x}$$

Since in our case y is in inches and x in feet the slope is thus expressed in inches per foot. In ship work it is more customary to express slope or bevel in thirty-seconds of an inch per foot. Our relation for bevel thus becomes

$$\theta = 64\frac{y}{x}$$

and this relation is incorporated in the nomogram being read off simultaneously with y.

Calculation of Bevels

The calculation of bevels forms the best application of the nomogram, since cambers and sheer heights are usually constructed by geometrical methods. The want of a knowledge of the precise bevel at any point of a deck surface is most felt in joiner work. As it is essential that the various items of furniture, etc., be made without reference to the ship, the joiner must be supplied with information concerning the bevel of the deck transversely and fore and aft. Most frequently the information is obtained by the joiner making a visit to the loftsman and, if fortunate, coming away with the requisite beam mold. From this mold all transverse bevels can be obtained. The fore and aft bevels, however, cannot be so obtained and generally the information is supplied from the drawing office in the form of the relevant sheer heights. Frequently, however, bevel is neglected in the putting together the article (such as wardrobe, etc.) in the joiner shops, and the necessary adjustment is effected in the ship.

When the type of ship built in a particular yard is fairly constant the joiner usually dispenses with any reference to the beam-mold and contents himself with a small table which purports to give the bevel at various distances out from the centerline. When the beam of the vessels built is fairly constant the bevels so calculated are fairly correct but not absolutely so. The correct basis for such a tabular method can be very easily deduced. Since the classification societies now recommend a standard beam camber of one-fiftieth of the midship beam we can see that our previous expression for bevel

$$\theta = 64\frac{cx}{b^2}$$

with $c = \frac{12}{50} \times 2b = .48b$

becomes $\frac{64 \times .48b}{b}\frac{x}{b} = 30.72\frac{x}{b}$

Thus for constant percentages of the midship beam the bevel is constant. When the standard camber was ¼ inch per foot of beam the expression for bevel would have become

$$\theta = 32\frac{x}{b}$$

which is a very simple rule for the joiner to remember. Expressed in words we could have said that the bevel at any distance from the centerline was the number of thirty-seconds which the distance represents as a fraction of the midship half beam.

While the foregoing considerations show that the calculation of bevel is a very simple process it is a moot point whether the drawing office should relegate it in any and every case to the foreman joiner. With the aid of the nomogram accompanying this article contours of iso-bevel lines (both transverse and fore and aft) could be indicated on the joiner's plan. If bevel intervals of 5 be adopted, the work involved is only a question of a few minutes on the draftsman's part. The joiner's preparation work, however, is considerably simplified. He can prepare a door list or lists of other details affected by bevel very readily and thus enable a good run of work to be scheduled.

The bevel standard adopted (*i.e.*, thirty-two seconds of an

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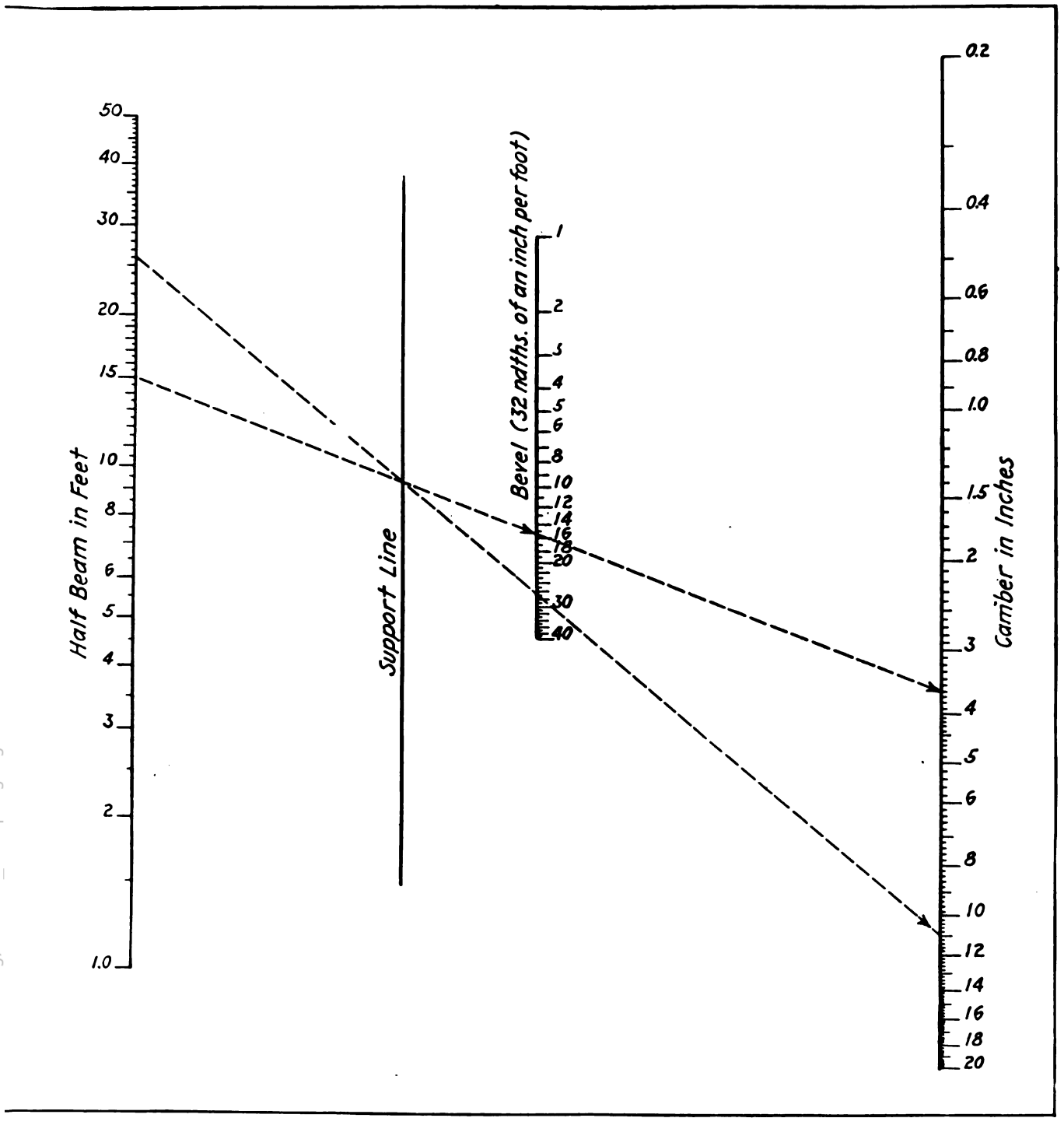

Fig. 1.—Deck Camber, Sheer and Bevel Nomogram

Example: Midship half-beam = 26 feet, midship camber = 11 inches, therefore camber at 15 feet out = 3.6 inches, while the bevel number is 15½.

nch per foot) is usually known as the Phipps standard. Phipps introduced a patent slide rule of which one portion was identical with the well known camber scale. To obtain he bevel, say for a door, the camber had to be read off at he inboard and outboard edges and the difference in the camber noted. Another slide representing the width of the article whose bevel was required was next introduced. This slide accomplishes the ordinary operation of division. The width of the object is placed opposite the difference in camber and opposite the unit on the width scale the bevel is read off on a further scale carried on the stock of the slide rule.

The advantages of nomogram over Phipps' scale are obvious. The operator has no separate calculation to perform, the nomogram giving immediately the correct bevel at any point. Incidentally Phipps' scale cannot do this. If, for example, the bevel for a 3-inch door frame be required, the difference in camber can only be guessed at with the Phipps scale, the corresponding bevel over the 3-inch being possibly very wide of the mark.

In using the nomogram the bevel at any point in the width of an object can be obtained. Actually, of course, the bevel at the center of the object will be the one used in practice. When the bevel system is adopted material can be cut to shape without any preliminary marking off, once corresponding bevel indicators are fitted to say the tenoning machine table or the circular saw table. The bevel system lends itself exceptionally well to the sub-contracting of ship's furniture and appears to be in fairly general use in larger yards.

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Water Rates of Marine Reciprocating Engines—II*

Correction for Fractional Loads—Superheat—Variations—Triple Versus Quadruple Expansion Engines — Problems Illustrating Methods of Estimating Water Rates

By E. A. Stevens, Jr.†

WHEN the load on a reciprocating engine is decreased the water rate changes. This change depends upon how this decrease in power is obtained and the characteristics of the engine. If the reduction of power is caused by advancing the high pressure cut-off, keeping the throttle wide open until the linking block is run all the way in, the water rate decreases until about 60 percent of full power is reached. On the other hand, if the high pressure cut-off is kept constant and the engine throttled down, the water rate will remain practically constant as the power is decreased until about 80 percent of full power is reached; below this the water rate rises.

If the mean referred pressure is high and the speed of the live and exhaust steam through the valve ports are high, the drop in water rates will be greater than that shown with advance cut-off, while with constant cut-off the water rate will drop until a certain load factor (depending upon the mean referred pressure and steam speeds at full power) is reached when it will begin to rise. The curves in Fig. 7 are for engines with mean referred pressure at full load, from 34 to 38 pounds.

Example No. 4

Find the water rate at 90, 80, 70 and 60 percent load of the engine given in Example No. 3, with advancing high pressure cut-off and with constant high pressure cut-off.

Percent of Full Load	Advancing High Pressure Cut-Off Multiplier*	Water Rate	High Pressure Cut-Off Constant Multiplier*	Water Rate
100	1.0	13.32	1.0	13.32
90	0.969	12.91	0.997	13.28
80	0.953	12.70	1.005	13.38
70	0.943	12.56	1.023	13.62
60	0.936	12.47	1.047	13.95

*From Fig. 7.

Superheat

Superheat affects the engine in three ways. First, it decreases the mean referred pressure, therefore the power, assuming that the high pressure cut-off and initial pressure are kept constant. Second, it decreases the water rate. Third, it affects the distribution of power in the various cylinders. This subject (the distribution of power), however, will not be discussed in this work. For a discussion of this subject, the reader is referred to "The Design of Marine Engines and Auxiliaries," by Professor Edward M. Bragg.

If it is desired to install superheat in a ship already constructed without reducing the power, one or two things can be done. First, decrease the number of expansions by either retarding the high pressure cut-off or enlarging the high pressure cylinder. The second is to decrease the pitch of the propeller and allow the engine to run at a higher number of revolutions.

If the ship is fitted with a built-up propeller, decreasing pitch is the cheapest, especially if this can be done during her periodical dry-docking, or if for other reasons her propeller is to be changed. This, however, should not be done unless the following conditions prevail. First, if the present revolutions are low or not excessive for the particular type of vessel or machinery; second, if the mean referred pressure under average operating conditions, after the change is made, will not be too low for economical operation. Third, if the ports and passages from the valves to the cylinders are of size that, with the increased revolutions, the speed of the and exhaust steam will not be excessive.

To increase the size of the high pressure cylinder is an expensive proposition and is not generally resorted to less necessary. If the engine is fitted with short valves long crooked ports, which means large clearances, some provement can be made, if a new high pressure cylinder be installed, by lengthening the valve, thereby shortening ports and decreasing the clearances of the new cylinder.

In most cases the desired power can be obtained by ing the high pressure cut-off. If the superheat is high the high pressure cut-off is rather late, it may not be pos to retard the latter enough. In this case, it would in instances be advisable to replace the high pressure cyl with a larger one, and in others to retard the high-pres cut-off as much as possible and decrease the pitch of propeller.

To make an estimate of the water rate of an engine superheated steam, first estimate the water rate of an en using saturated steam with the same initial and back pressures and with the necessary expansions to give the mean referred pressure as the one using superheat, then the correction for superheat (see Fig. 8).

Example No. 5

Given a triple expansion engine using superheated steam 120 degrees F., initial pressure $P_i = 200$ pounds absolute, ex sions $R_a = 9.75$; H.P. clearance $Cl_H = .12$; M.P. clearance = = .10; L.P. clearance = $Cl_L = .08$; average clearance = mean referred pressure (M.R.P.) = 36; back pressure P_b = M.R.P.$_o$ = M.R.P. + P_b = 36 + 4 = 40; find water rate.

From Fig. 1, we find that when 120 degrees F. superheat used, M.R.P.$_o$ (or M.R.P. + P_b) is 92.5 percent of what it would be if saturated steam was used. Therefore, the M.R.P. saturated steam (at $R_a = 9.75$) would have been $40 \div 0.92$ 43.24. Plotting this point on $R_a = 9.75$ (Fig. 1) we find that falls slightly above the curve for $P_i = 200$. From this point down and to the right of the chart, using curve $P_i = 200$ direction line, until M.R.P.$_o$ = 40 is reached; at this point we $R_a = 11.05$ which would have been the expansions (R_a) to the desired M.R.P. if saturated steam was used. Our problem then first to find the water rate of an engine using saturated at 200 pounds absolute initial pressure, expansions of 11.05 mean referred pressure of 36 pounds.

$P_{co} \div P_i$ (Fig. 2) = 0.788, then $P_{co} = 200 \times 0.788 = 157$ from Fig. 3 = $P_t \div P_{co} = 0.079$, then $P_t = 157.6 \times 0.079 = 12$

From Fig. 4, we find that the weight of steam per cubic foot 12.43 pounds absolute pressure is 0.032 pound and from Fig. correction factor for the average clearance M_{cl} is 1.00. The water rate of an engine using saturated steam at $P_i = 200$ and = 11.05 is

$$W.R. = \frac{13750 \times (1+Cl_L)\ \Delta \times M_{cl}}{M.R.P.} = \frac{13750 \times 1.08 \times .032}{36}$$

= 13.21.

From Fig. 8, we find that an engine using 120 degrees superheat will use 88.3 percent of the steam required if saturated steam is used. Therefore, the water rate would 13.21 × 0.883 = 11.65.

This can be calculated in one operation, thus:

$$W.R. = \frac{13750 \times \Delta \times (1+Cl_L) \times M_{cl} \times M_s}{M.R.P.}$$

$$= \frac{13750 \times .032 \times 1.08 \times 1.00 \times 0.883}{36} = 11.65$$

To find the water rate at fractional load, proceed as explained

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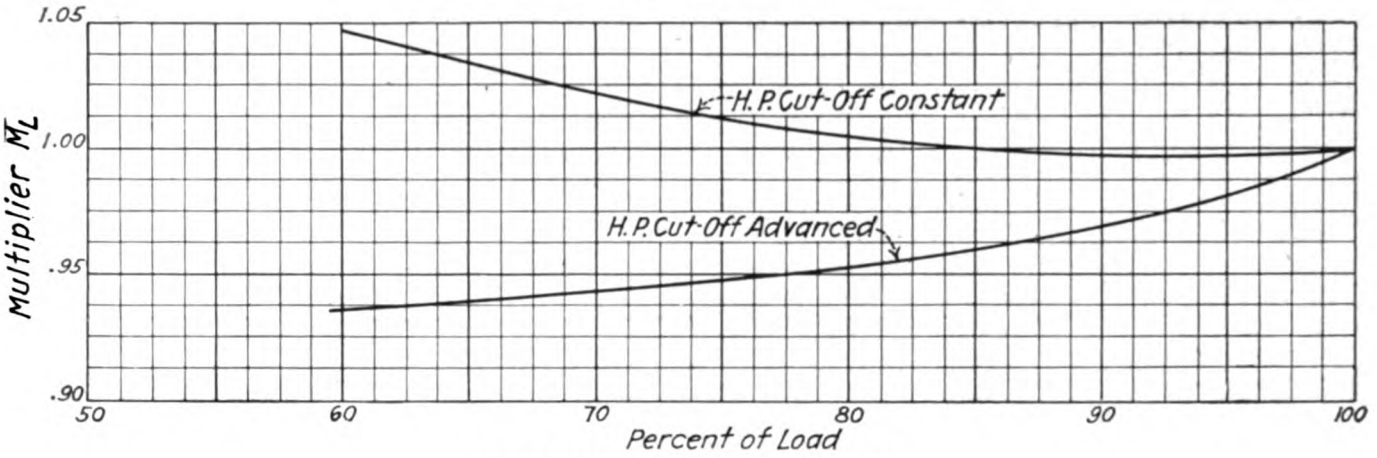

Fig. 7.—Correction for Reduced Loads

in Example No. 4, except 11.65 pounds is used as the water rate for full load in place of 13.32.

VARIATIONS

The values of M.R.P_o. (Fig. 1) and $P_{co} \div P_i$ (Fig. 2) are the average values met within practice. Should, however, these vary, the water rates may not be quite the same as calculated.

If the high pressure cut-off pressure should be higher or lower than that estimated, with a corresponding increase or decrease in the mean referred pressure, the water rate will be approximately that calculated but the power will be either greater or less.

Should the high pressure cut-off pressure be equal to that estimated but the mean referred pressure be less, the water rate would be greater, while with a higher mean referred pressure than that calculated, the water rate would be less.

TRIPLE VERSUS QUADRUPLE EXPANSION ENGINES

There is quite some difference of opinion regarding the merits of triple and quadruple expansion engines. The advocates of the former claim that the reason for the better showing of the quadruple is because they use higher pressures and greater expansions,* while those favoring the latter insist that the saving is due to the smaller temperature drop in each cylinder, thereby reducing the initial condensation. This last argument, however true it may be, is offset, at least to some extent, by the greater radiating surfaces of the quadruple, besides having one more set of ports and passages for the steam to pass through and an additional set of clearances to fill at each revolution.

In the few cases in the merchant service (using Scotch boilers) coming to the writer's attention where a boiler pressure of 220 pounds gage and 12.5 expansions were used with triple expansion engines, the results have been very gratifying. While there were no water consumption tests made on these engines, the performances of the ships in operation indicate that the water rates, if tested, would show as good as a quadruple of equal power and length of stroke and running under the same conditions regarding boiler pressure, vacuum and revolutions.

To sum up, it would appear that if the same pressure and expansions were used and the clearances of the high and low pressure cylinders were approximately the same for the two types and that of the intermediate pressure cylinder of the triple was about the same as the mean of the clearances of the first and the second intermediate pressure cylinders of the quadruple, there would be very little, if any, difference in the water rates of the two types.

*The present merchant marine practice, where Scotch boilers are used, is to use a boiler pressure of 190 to 200 pounds gage, and about 10 to 11.5 expansions with triples, and about 220 pounds gage on 12.5 to 13.5 expansions for quadruples.

PROBLEMS

The following problems are given to illustrate how to estimate the mean referred pressure and water rate of a new engine that has not been built and also how to estimate the water rate of an engine after having the trial trip data.

PROBLEM NO. 1.

Given a quadruple expansion engine using saturated steam.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	25	476.74	10.8
I.M.P. cylinder	35	947.97	8.52
2 M.P. cylinder	51	2028.69	7.36
L.P. cylinder	75	4403.73	7.05
Piston rod	6	Stroke 51 inches	

High pressure cut-off = 69 percent

$$\text{Expansion } R_a = \frac{4403.73 \times 1.0705}{476.74 \times (.108 + .69)} = 12.45$$

Average clearance $Cl_A = 8.43$ percent

Boiler pressure = 220 pounds gage = 235 absolute

Initial pressure P_i (assumed) = 225 pounds absolute

$$\text{Vacuum} = 26 \text{ inches; condenser pressure} = \frac{30\text{-}26}{2} = 2 \text{ pounds absolute}$$

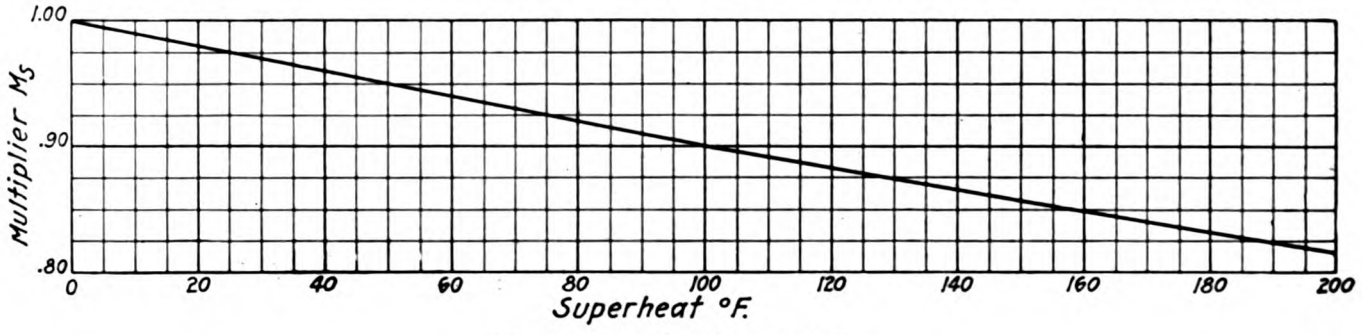

Fig. 8.—Correction for Superheat

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Back pressure P_b assumed to be 2 pounds higher than condenser pressure = 2 + 2 = 4 pounds absolute
M.R.P$_o$. (from Fig. 1) = 39.8
M.R.P. = M.R.P$_o$. − P_b = 39.8 − 4 = 35.8
P_{eo} − P_t (from Fig. 2) = 0.766
High pressure cut-off pressure = P_{eo} = 225 × 0.766 = 172.4 pounds absolute
$P_t \div P_{eo}$ (from Fig. 3) = 0.069
Terminal pressure = P_t = 172.4 × 0.069 = 11.90 pounds absolute
From Fig. 4 weight of 1 cubic foot of steam (Δ) at 11.9 pounds absolute pressure is 0.0306 pound
From Fig. 5 the correction factor for clearance
M_{c1} (for an average clearance Cl_A = 8.43 percent) is 0.997
Low pressure clearance Cl_L as given above = 7.05 percent or 0.0705
Then

$$\text{Water rate} = \text{W.R.} = \frac{13750 \times \Delta \times (1 + Cl_L)}{\text{M.R.P.}} \times M_{c1}$$

$$= \frac{13750 \times 0.0306 \times 1.0705}{35.8} \times 0.997$$

$$= 12.56 \text{ pounds.}$$

Problem No. 2

Given a triple expansion engine using superheated steam.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	24.5	458.5	8.66
M.P. cylinder	41.5	1339.7	7.66
L.P. cylinder	72	4058.5	7.68
Piston rod	5.75	Stroke 48 inches	

High pressure cut-off = 75 percent

$$\text{Expansion} = R_a = \frac{4058.5 \times 1.0768}{458.5 \times (.0866 + .75)} = 11.38$$

Average clearance = 8 percent
Boiler pressure 200 pounds gage = 215 pounds absolute
Initial pressure P_i assumed = 205 pounds absolute
Superheat at throttle = 100 degrees F.

$$\text{Vacuum} = 26 \text{ inches; condenser pressure} = \frac{30\text{-}26}{2} = 2 \text{ pounds absolute}$$

Back pressure P_b assumed to be 2 pounds higher than condenser pressure = 2 + 2 = 4 pounds absolute
M.R.P$_o$. (from Fig. 1) = 39.6
Correction factor for 100 degrees F. superheat (from Fig. 1) = 0.935
Estimated M.R.P$_o$. corrected for 100 degrees F. superheat = 39.6 × 0.935 = 37.03
M.R.P. = corrected M.R.P$_o$. − P_b = 37.03 − 4 = 33.03 pounds.
Now find expansions R_a for P_i = 205 and M.R.P$_o$. = 37.03 from Fig. 1, which is found to be 12.85
First find water rate for an engine using saturated steam at P_i = 205, R_a = 12.85 and M.R.P. = 33.03
$P_{eo} \div P_i$ (from Fig. 2) = 0.783
High pressure cut-off pressure P_{eo} = 205 × 0.783 = 160.5 pounds absolute
$P_t \div P_{eo}$ (from Fig. 3) = 0.067
Terminal pressure P_t = 160.5 × 0.067 = 10.76 pounds absolute
Δ (from Fig. 4) = 0.0278 pound
From Fig. 5 the correction factor for clearance M_{c1} = 0.996
Then for an engine using saturated steam with R_a = 12.85, P_i = 205 pounds absolute and M.R.P. = 33.03, the water rate would be

$$\text{W.R.} = \frac{13750 \times \Delta \times (1 + Cl_L)}{\text{M.R.P.}} \times M_{c1}$$

$$= \frac{13750 \times 0.0278 \times 1.0768}{33.03} \times 0.996 = 12.41 \text{ pounds}$$

From Fig. 8 we find the correction factor for 100 degrees F., superheat is 0.90, then the water rate of this engine using 100 degrees F. superheated steam at 205 pounds absolute; R_a = 11.38 and M.R.P.=33.03 is 12.41×0.9=11.17 pounds.

The two problems just given show how to estimate the water rate of an engine which has not been built. The following problems will show how to estimate the water rate of engines after receiving the trial trip data.

Problem No. 3

Quadruple expansion engine, same dimensions as given in Problem No. 1.
High pressure cut-off on trial trip = 0.67
Expansions R_a = 12.73
Initial pressure P_i = 217 pounds gage = 232 pounds absolute
M.R.P. = 34.7 pounds
$P_{eo} \div P_i$ (from Fig. 2) = 0.761
$P_{eo} = P_i \times (P_{eo} \div P_i) = 232 \times 0.76 = 176.6$
$P_t + P_{eo}$ (from Fig. 3) = 0.068
$P_t = P_{eo} \times (P_t \div P_{eo}) = 176.8 \times 0.068 = 12.01$
Δ (from Fig. 4) = 0.031
M_{c1} (from Fig. 5 for Cl_A = 8.43 percent) = 0.998

$$\text{Water rate} = \frac{13750 \times \Delta \times (1 + Cl_L)}{\text{M.R.P.}} \times M_{c1}$$

$$= \frac{13750 \times 0.031 \times 1.0705}{34.7} \times 0.998$$

$$= 13.12 \text{ pounds}$$

Actual water rate = 12.8 pounds.

Problem No. 4

Triple expansion engine using saturated steam barrels of all cylinders are jacketed.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	29	646.39	12.4
M.P. cylinder	44	1506.37	9.3
L.P. cylinder	70	3834.37	8.0

Piston rod about 6.25 inches, stroke 48 inches
Average clearance Cl_A = 9.9
High pressure cut-off estimated from cards=0.524

$$\text{Expansions } R_a = \frac{3834.37 \times 1.08}{646.39\ (.524 + .124)} = 9.89$$

Initial pressure P_i = 158 pounds absolute
M.R.P. = 30.08
$P_{eo} \div P_i$ (from Fig. 2)=0.836
$P_{eo} = P_i \times (P_{eo} \div P_i) = 158 \times 0.836 = 132.1$ pounds absolute
$P_t \div P_{eo}$ (from Fig. 3) = 0.088
$P_t = P_{eo} \times (P_t \div P_{eo}) = 132.1 \times 0.088 = 11.63$ pounds absolute
Δ (from Fig. 4) = 0.03
M_{c1} (from Fig. 5) = 1.00
M_J (from Fig. 6) = 1.014

$$\text{Water rate} = \frac{13750 \times \Delta \times (1 + Cl_L)}{\text{M.R.P.}} \times M_{c1} \times M_J$$

$$= \frac{13750 \times 0.03 \times 1.08}{30.08} \times 1.00 \times 1.014$$

$$= 15.02 \text{ pounds.}$$

Actual water rate = 14.98 pounds.

Problem No. 5

Triple expansion engine.

	Diameter inches	Mean area square inches	Percent clearance
H.P. cylinder	18.75	269.4	9.99
M.P. cylinder	29	653.8	6.71
L.P. cylinder	45	1583.7	6.55
Piston rod	4.125	Stroke 26 inches	

Average clearance Cl_A = 7.75 percent
High pressure cut-off estimated from cards=0.74

$$\text{Expansions } R_a = \frac{1583.7 \times 1.0655}{269.4 \times (.74 + .0999)} = 7.46$$

Initial pressure P_i = 170 pounds absolute
M.R.P. = 34.55
$P_{eo} \div P_i$ (from Fig. 2)=0.819
$P_{eo} = P_i \times (P_{eo} \div P_i) = 170 \times 0.819 = 139.2$ pounds absolute
$P_t \div P_{eo}$ (from Fig. 3) = 0.119
$P_t = P_{eo} \times (P_t \times P_{eo}) = 139.2 \times 0.119 = 16.56$ pounds absolute
Δ (from Fig. 4) = 0.0416
M_{c1} (from Fig. 5) = 0.997

$$\text{Water rate} = \frac{13750 \times \Delta \times (1 + Cl_L)}{\text{M.R.P.}} \times M_{c1}$$

$$= \frac{13750 \times 0.0416 \times 1.0655}{34.55} \times 0.997 = 17.6 \text{ pounds}$$

Actual water rate = 17.33 pounds.

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PROBLEM No. 6

Four cylinder triple expansion engine.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	28.25	611.5	26.4
M.P. cylinder	45	1575.1	21.34
L.P. cylinders (2)....	62	3003.8 each	21.25

Piston rod about 6.25 inches, stroke 36 inches
Average clearance $Cl_A = 22.99$ percent
High pressure cut-off = 0.79

$$\text{Expansions} = R_a = \frac{6007.6 \times (1 + .2125)}{611.5 \times (.264 + .79)} = 11.3$$

Initial pressure $P_i = 244$ pounds absolute
M.R.P. = 34.75
$P_{eo} \div P_i$ (from Fig. 2) = 0.752
$P_{eo} = P_i \times (P_{eo} \div P_i) = 244 \times 0.752 = 183.5$
$P_t \div P_{eo}$ (from Fig. 3) = 0.077
$P_t = P_{eo} \times (P_t \div P_{eo}) = 183.5 \times 0.077 = 14.14$
Δ (from Fig. 4) = 0.036
M_{ei} (from Fig. 5) = 1.022

$$\text{Water rate} = \frac{13750 \times \Delta \times (1 + Cl_L)}{\text{M.R.P.}} \times M_{ei}$$

$$= \frac{13750 \times 0.036 \times 1.2125}{34.75} \times 1.022 = 17.65 \text{ pounds}$$

Actual water rate = 17.4 pounds.

PROBLEM No. 7

Four cylinder triple expansion engine using saturated steam.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	34	888.68	25
M.P. cylinder	55.5	2399.96	20
L.P. cylinders (2)	64	3197.75 each	15

Piston rod about 7 inches, stroke 48 inches
Average clearance $Cl_A = 20$ percent
High pressure cut-off = 0.71

$$\text{Expansions } R_a = \frac{6395.5 \times 1.15}{888.68 \times 0.96} = 8.61$$

Initial pressure $P_i = 245$
M.R.P. = 47.3
$P_{eo} \div P_i$ (from Fig. 2) = 0.751
$P_{eo} = P_i \times (P_{eo} \div P_i) = 245 \times 0.751 = 184$
$P_t \div P_{eo}$ (from Fig. 3) = 0.102
$P_t = P_{eo} \times (P_t \div P_{eo}) = 184 \times 0.102 = 18.77$
Δ (from Fig. 4) = 0.0469
M_{ei} (from Fig. 5) = 1.017

$$\text{W.R.} = \frac{13750 \times 0.0469 \times 1.15}{47.3} \times 1.017 = 15.95 \text{ pounds}$$

Actual water rate = 15.75 pounds.

When the steam jackets were used on the barrels of all the cylinders the M.R.P. was 47.4.
M_J (from Fig. 6) = 1.055

$$\text{W.R.} = \frac{13750 \times 0.0472 \times 1.15}{47.4} \times 1.017 \times 1.055 = 16.9 \text{ pounds}$$

Actual water rate = 16.64 pounds.

PROBLEM No. 8

Four cylinder triple expansion engine intermediate and low pressure cylinder jacketed. Superheat at throttle 43.2 degrees F. As this superheat is so slight, no correction will be made for same.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	39	1167.9	13.92
M.P. cylinder	63	3090.5	13.53
L.P. cylinders (2)	83	5383.9 each	15.02
Piston rods	8.25	Stroke 48 inches	

Average clearance $Cl_A = 14.15$ percent
High pressure cut-off = 0.819

$$\text{Expansions } R_a = \frac{10767.8 \times 1.15}{1167.9 \times (0.1392 + 0.819)} = 11.07$$

Initial pressure $P_i = 268$
M.R.P. = 44.4
$P_{eo} \div P_i$ (from Fig. 2) = 0.737
$P_{eo} = P_i \times (P_{eo} \div P_i) = 268 \times 0.737 = 197.5$
$P_t \div P_{eo}$ (from Fig. 3) = 0.079
$P_t = P_{eo} \times (P_t \div P_{eo}) = 197.5 \times 0.079 = 15.6$
Δ (from Fig. 4) = 0.0395
M_{ei} (from Fig. 5) = 1.007

As mentioned in the text, jacketing the barrels of the intermediate and low pressure cylinders has about the same effect as jacketing all barrels and, if the heads are jacketed, the increase in water rate will be about 50 percent more than that if the barrels only were jacketed. From Fig. 6 we find that with the M.R.P. = 44.4 the increase is 4.5 percent when barrels only are jacketed, then increase when heads and barrels are jacketed will be 6.7 percent and $M_J = 1.067$. Then

$$\text{W.R.} = \frac{13750 \times \Delta \times (1 + Cl_L)}{\text{M.R.P.}} \times M_{ei} \times M_J$$

$$= \frac{13750 \times 0.0395 \times 1.15}{44.4} \times 1.007 \times 1.067 = 15.11 \text{ pounds}$$

Actual water rate = 14.92 pounds.

PROBLEM No. 9

Four cylinder triple expansion engine using about 60 degrees F. superheat. The barrels of all cylinders and the ends of the intermediate and low pressure cylinders were jacketed. As the

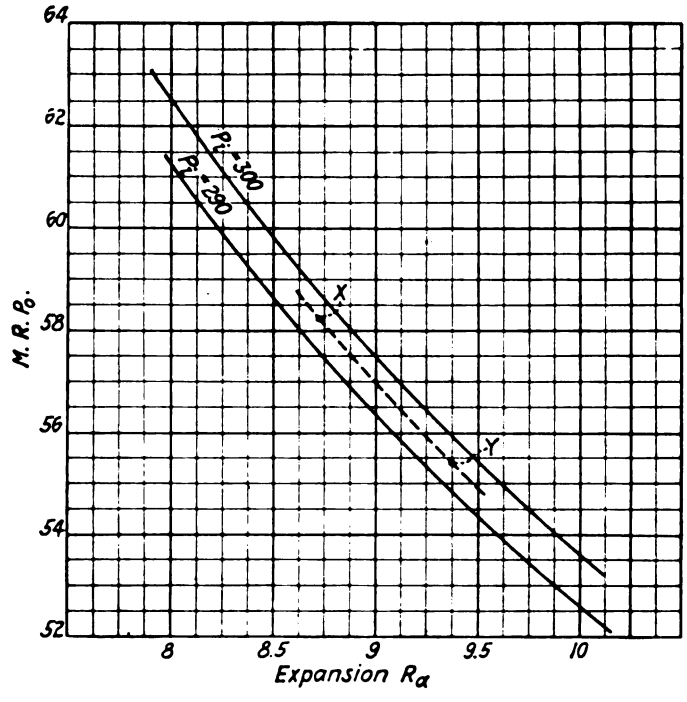

Fig. 1A

steam used in the jackets was measured with that used by the auxiliaries no correction will be made for the jackets.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	38.5	1139.1	16.17
M.P. cylinder	57	2526.7	13.57
L.P. cylinders (2).....	76	4511.4 each	12.49
Piston rod	8	Stroke 48 inches	

Average clearance $Cl_A = 14.05$
High pressure cut-off = 0.86

$$\text{Expansions } R_a = \frac{9022.8 \times 1.1249}{1139.1 \times (0.86 + 0.1617)} = 8.73$$

Initial pressure $P_i = 268$ pounds absolute
Superheat = 61 degrees F.
M.R.P. = 50.95
Back pressure $P_b = 4.46$
$M.R.P._{ab} = M.R.P. + P_b = 50.95 + 4.46 = 55.41$.

The next step is to find the expansions necessary to give the above $M.R.P._{ab}$ of 55.41, if saturated steam is used.

From Fig. 1 we find the effect that 61 degrees F. of superheat has on $M.R.P._{ab}$ is 0.953. Then the $M.R.P._{ab}$ of this engine with the above initial pressure and expansions ($P_i = 268$ and $R_a = 8.73$) when saturated steam is used would be $55.41 \div 0.953 = 58.2$. As this point ($R_a = 8.73$ and $M.R.P._{ab} = 58.2$) does not fall on Fig. 1 curves will have to be constructed as shown on Fig. 1A.

This point*, $R_a = 8.73$ and $M.R.P._{ab} = 58.2$ will plot on Fig. 1A at point x, which is about midway between lines $P_i = 290$ and

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$P_1 = 300$. Move down and to the right using lines $P_1 = 290$ and $P_1 = 300$ as direction lines (as shown by dotted line) until M.R.P.$_o$ $= 55.41$ is reached, which is at point Y. At this point we find the expansions $R_a = 9.37$.

Now find the water rate of an engine using saturated steam at $P_1 = 268$, $R_a = 9.37$ and M.R.P. $= 50.95$ and multiply it by the correction factor for superheat M_s from Fig. 8.

$P_{co} \div P_1$ (from Fig. 2) $= 0.737$

$P_{co} = P_1 \times (P_{co} \div P_1) = 268 \times 0.737 = 197.5$ pounds absolute

$P_t \div P_{co}$ (from Fig. 3) $= 0.093$

$P_t = P_{co} \times (P_t \div P_{co}) = 197.5 \times 0.093 = 18.37$

Δ (from Fig. 4) $= 0.046$

M_{c1} (from Fig. 5) $= 1.007$

M_s (from Fig. 8) $= 0.939$

Then the water rate will be

$$W.R. = \frac{13750 \times \Delta \times (1 + Cl_L)}{M.R.P.} \times M_{c1} \times M_s$$

$$= \frac{13750 \times 0.046 \times 1.124}{50.95} \times 1.007 \times 0.939$$

$= 13.19$ pounds

Actual water rate $= 13.38$.

PROBLEM No. 10

This problem will show the procedure to follow in order to determine the position of the high pressure cut-off, when a change is made from a saturated steam outfit to one using superheat without decreasing the power, and to estimate the saving in the steam consumption by this change. The engine being a four cylinder triple expansion passenger ship type.

	Diameter, inches	Mean area, square inches	Percent clearance
H.P. cylinder	24	435.8	13.18
M.P. cylinder	40½	1271.66	9.56
L.P. cylinders (2)	54	2273.64 each	4.69
Piston rod	6½	Stroke 45 inches	

Average clearance $Cl_A = 9.14$ percent

High pressure cut-off $= 75$ percent

$$\text{Expansion } R_a = \frac{4547.28 \times (1 + 0.0469)}{435.8 \times (0.1318 + 0.75)} = 12.4$$

Initial pressure $P_1 = 207$ pounds gage $= 222$ pounds absolute

M.R.P. 34.7, $P_b = 4.5$

M.R.P$_o$. $=$ M.R.P. $+ P_b = 34.7 + 4.5 = 39.2$ pounds.

If 150 degrees F. is the desired amount of superheat, then the correction factor for M.R.P$_o$. from Fig. 1 is 0.912, and as it is desired to keep the above M.R.P. of 34.7, the above value of M.R.P$_o$. $= 39.2$ should be divided by 0.912 to obtain the new value of M.R.P$_o$. (which will be called M.R.P$_{os}$.) in order to determine the expansions to use with superheat.

M.R.P$_{os}$. $=$ M.R.P$_o$. $\div 0.912 = 39.2 \div 0.912 = 43$

Plot on Fig. 1 M.R.P$_o$. $= 39.2$ and $R_a = 12.4$. We find that this point falls slightly below the line of $P_1 = 220$. Now pass up and to the left using line $P_1 = 220$ as a direction line until M.R.P$_o$. $= 43$ (which $=$ M.R.P$_o$.) is reached. At this point we find that $R_a = 10.58$ which will be called R_{as}. Letting the new high pressure cut-off be called CO_s and the new expansions R_{as} we have

$$R_{as} = 10.58 = \frac{4547.28 \times 1.0469}{435.8 \times (0.1318 + CO_s)}$$

$$= 10.58 = \frac{10.925}{0.1318 + CO_s}$$

$$\text{Then} \quad 0.1318 + CO_s = \frac{10.925}{10.58} = 1.033$$

and $CO_s = 1.033 - 0.1318 = .9012$ or 90 percent.

Now find the water rate for this engine using saturated steam and 12.4 expansions.

$P_1 = 222$ pounds absolute

$P_{co} \div P_1$ (from Fig. 2) $= 0.768$

$P_{co} = 222 \times 0.768 = 170.5$ pounds absolute

$P_t \div P_{co} =$ from Fig. 3 (for original expansions $R_a = 12.4$) $= 0.07$

$P_t = 170.5 \times 0.07 = 11.94$ pounds absolute

Δ (from Fig. 4) $= 0.0308$

M_{c1} (from Fig. 5) $= 1.00$

Water rate with saturated steam

$$W.R. = \frac{13750 \times 0.0308 \times 1.0469}{34.7} \times 1.00 = 12.78 \text{ pounds.}$$

From Fig. 8 we find the correction factor for superheat of 150 degrees F. $= 0.857$.

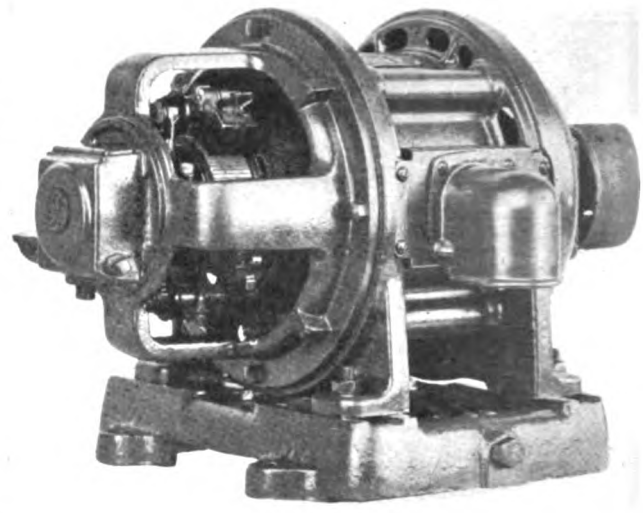
Then water rate with 150 degrees F. superheat and expansions $R_a = 10.58 = 12.78 \times 0.857 = 10.95$ pounds.

This represents a saving of 1.83 pounds per indicated horsepower per hour and as the ship had twin screws and the indicated horsepower of both engines at full load was 7,500 the saving in fuel per day (taking an evaporation of 13.5 pounds of water per pound of oil) would be $\frac{7500 \times 1.83 \times 24}{13.5 \times 2240} = 10.89$ tons.

*It will be noticed that the corrected M.R.P$_o$. of this engine is considerably higher than that given for $P_1 = 268$ and $R_a = 8.73$. This is due to the cylinders being steam jacketed and the ports from the valves to the cylinders being straight and well proportioned.

Induction Motors for Shop Use

TWO new types of induction motors are being placed on the market by the General Electric Company, Schenectady, N. Y. One type is designated as the SCR single phase motor which is designed for a constant speed at 60, 50 and 40 cycles in sizes from ½ to 10 horsepower and interchangeable for 110 or 220-volt circuits. The second, known as the KT-900 type, is a riveted frame, polyphase



New Single Phase Induction Motor

induction motor of 3 and 2-phase squirrel cage 60 cycle design and is being sold in sizes ranging from ½ to 15 horsepower.

The new single phase motor, operating on the squirrel cage induction principle, entirely eliminates the short circuit switches heretofore considered essential and permits a simple form of construction. It combines high starting torque with low current demand and has operating characteristics similar to those for the induction motor.

The polyphase motor is a 40-degree continuous duty riveted frame machine. The electrical improvements embodied in this new line comprise reduced heating, higher efficiency and higher power factor at full and fractional loads and increased starting torque.

The principal mechanical improvements include from 50 to 100 percent increase in oil reservoir capacity, a new method of directing ventilating air to prevent dirt from settling on the windings and a cast rotor of one-piece construction having neither joints nor high resistance spots.

AMERICANIZING CREWS OF AMERICAN VESSELS.—The Shipping Board has adopted a plan formulated and approved by T. V. O'Connor, chairman, the result of which will be to place upon each of the Shipping Board vessels two boys who will be given the classification of engine room and deck boys and who will serve as such until, in the discretion of the master, they can qualify to be signed on as ordinary seamen.

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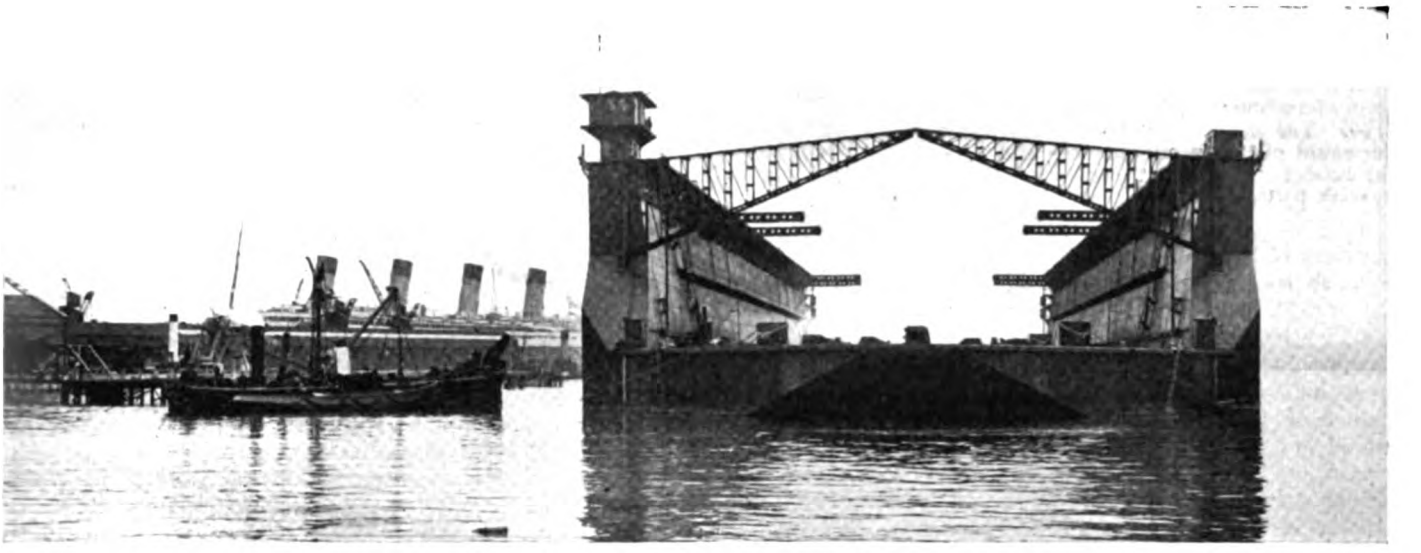

The New 60,000-Ton Floating Dry Dock at Southampton, Eng.

British Shipping and Shipbuilding Developments

London's Increased Port Charges Arouse a Storm of Protest — Spanish Tax on Maritime Traffic Bitterly Opposed — Shipbuilders Face Financial Difficulties

By W. H. Wendon

ONE of the fiercest "storms" of recent years has raged over increased port charges brought into operation by the Port of London Authority as from April 1. The Authority contends that the increase is justified owing to the extra two shillings a day which has had to be conceded to port workers, but shipowners and traders have endeavored to make it clear that the Authority's new charges are considerably in advance of the total sum granted to the men in increased wages. The Authority's reply to criticisms is that charges were reduced to too low a level in 1923, but, as against this, the critics declare that the Authority has amassed reserve funds far and above what is reasonably required.

Apart from its financial aspect, however, this controversy has a strong political flavor. The whole subject may, in fact, be said to have arisen from the coming into office of the first Labor Government. The Government, although held in check by the twin "Opposition," has had a demoralizing effect on the views of the workers, and strikes have been rampant. The Port of London Authority is universally blamed for what is held to be its "jelly-fish" attitude towards the demands of the dockers, and, as a result, when it was seen how easily these men secured their demands, other branches of workers hastened to adopt similar tactics. This accounts for the bitter tone taken up in many quarters against the "P. L. A."

Scandinavians Complain of British Port Facilities

Scandinavian shipping people are still pegging away at the alleged inferior facilities in existence at ports of the United Kingdom, and London comes in for a large share of the complaints. One leading Norwegian shipowner goes so far as to declare that in London's "Surrey Commercial Docks," to which most of the timber arriving in the Port of London is shipped, the facilities are about fifty years behind the times. Conditions generally at the docks in the United Kingdom are, he says, "anything but up-to-date."

This view is interesting in view of the great efforts which have been made since the close of last year to improve United Kingdom port conditions, following the serious complaints of a few months ago. Specially constituted committees have visited practically every port of consequence, and have drawn up reports which they have submitted to the responsible dock and harbor authorities. It is believed that the appointment of these committees has been well worth while, but if, as is unlikely, it has failed in some directions, it has certainly had one very satisfactory outcome: It has put some pep into the proposals of the port authorities in the matter of hastening the fruition of plans already decided on but, for various reasons, "held up." The task of the Inspection Committees was begun in November last, and the dock improvement and extension work has been accelerated to such an extent that, on a conservative estimate, work involving an expenditure of fifty millions sterling has either commenced or is about to begin.

Spanish Tax on Maritime Traffic Resented

United Kingdom shipping interests are awaiting with a great amount of interest the outcome of a communication addressed by the British Foreign Office to the Spanish authorities on the subject of what is considered to be a most uncalled-for tax. Briefly, the tax is on maritime traffic, both passenger and cargo, carried by Spanish and foreign vessels to and from Spanish ports, "the proceeds of which will be applied to the repayment of losses suffered by shipowners who had their vessels requisitioned at reduced rates during the Great War." Put another way, British and other "foreign" owners are being penalized for the benefit of Spanish owners who, so it is alleged, did not make sufficiently large profits out of the war—although all the statistics available point to the earnings of Spanish shipping during the war period being on an enormous scale. The official reasons for imposing the tax are stated to be as follows:

(1) The Spanish Government admitted claims amounting to 125,000,000 pesetas for services rendered by Spanish shipowners during the war.

(2) The whole of the Spanish mercantile marine submitted to

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a levy which produced 50,000,000 pesetas within two years of the termination of the war.

(3) The slump in shipping caused a cessation of the contributions under the levy, and the State was obliged to seek some other form of revenue to meet the obligation.

(4) The Spanish shipowners agreed voluntarily, with the endorsement of the Directorate, to a gradual method of payment of the balance of the debt by means of a tax on all shipping using Spanish ports.

One of the instances recorded, illustrating the war-time earnings of Spanish shipping, relates to July, 1918, when a Spanish steamer carried a cargo of jute from Calcutta to Spain at the rate of £50 per ton, or a total freight of £296,000, whereas the average rate in 1913 and at the present time was, and is, in the neighborhood of 27 shillings. As I have indicated, British owners feel very strongly on this matter of taxation, and the disapproval which has been voiced has, as already stated, resulted in intervention on the part of the British Foreign Office.

The Spanish decree, it appears, is so framed as not to amount to a specific infraction of the Treaty obligations of Spain towards Great Britain, but it does, in the view of his Majesty's Government, "run counter to the spirit of these obligations." The Spanish Government has, therefore, been urged to "recognize the desirability, not merely of carrying out the actual letter of their undertakings, but to do nothing contrary to the spirit of those undertakings, and, indeed, of doing all in their power to give effect to the principles of the equal treatment in all respects of the flags of all nations, which have been generally accepted and embodied in the International Maritime Ports Convention recently concluded under the auspices of the League of Nations."

Cargo Owners to Be Protected Against Fraudulent Scuttling of Vessels

There has been a more than usually interesting sequel to a legal decision affecting the "scuttling," or throwing away, of a steamer. The vessel concerned was the *Gregorios*, and the House of Lords decided that an innocent cargo owner, who had hitherto been protected by his policy of insurance in cases of fraudulent scuttling, was no longer so protected, since fraudulent scuttling is not a peril covered by the marine policy. Following this important ruling, underwriters, both at Lloyd's and the companies, considered the best means of restoring to the innocent cargo owner that protection to which it was felt he was entitled. A new clause has now been drafted, accomplishing this object, the clause, which is to be added to the "Bills of Lading Clause" in the "Institute Cargo Clauses," being worded as follows:

> The assured are not to be prejudiced by the presence of the negligence clause and/or latent defect clause in the Bills of Lading and/or Charter-party. The seaworthiness of the vessel as between the assured and the assurer is hereby admitted and the wrongful act or misconduct of the ship-owner or his servants causing a loss is not to defeat the recovery by an innocent assured if the loss in the absence of such wrongful act or misconduct would have been a loss recoverable on the policy. With leave to sail with or without pilots, and to be towed and assist vessels or craft in all situations, and to be towed.

Financial Difficulties of Shipbuilders

The majority of the annual reports presented by United Kingdom shipbuilding, marine engineering and repairing concerns illustrate the difficulties under which such undertakings have been laboring for many months past. One such company records a loss, for the year ending June 30, 1923, of £14,661, but managed to get together a profit of £6,352 in the following six months. As, however, this is before providing anything for the usual depreciation, there is obviously "nothing in it" so far as actual profit is concerned. A further unsatisfactory feature is that the company's investments in associated concerns show a substantial depreciation in value. Nor can it be regarded as anything but an unhappy augury that, in the opinion of the directors, the time has not yet arrived to submit to the shareholders a scheme for the reorganization of the company's capital.

Another shipbuilding company sustained a loss, in the twelve months ending December 31 last, of £14,318, which, however, was after providing for all expenses except depreciation. But the directors are at least hopeful that the present indications of greater inquiry for tonnage may develop—given freedom from industrial disputes. A sign of the times is that the shareholders are being asked to empower the directors to dispose of such assets of the company as may be found most expedient with a view to improving the company's cash position.

Unsuccessful efforts have been made to dispose of the shipyard and plant of the Forth Shipbuilding and Engineering Company, of Alloa (Scotland). The ground extends to thirteen acres, and there are seven building berths for vessels up to 500 feet in length. At an auction, however, despite widespread publicity, not a single offer was forthcoming, though the "upset" price was, on the surface, the reasonable one of £30,000.

Loss of Self-Trimming Colliers

Vast interest has been taken in United Kingdom shipping circles in the rather mysterious circumstances surrounding the repeated losses of self-trimming colliers. Consequently a special committee, representative both of shipowners and of the Government Board of Trade, was constituted to inquire into these mishaps.

The committee's report just published reveals that during its investigations a list was prepared from Board of Trade records giving particulars of all British coal-laden steamers in voyages from the United Kingdom which foundered or were reported missing between January 1, 1921, and January 31, 1924. The vessels on this list numbered 26, but it was agreed that 11 of these should be eliminated, because they were, for various reasons, irrelevant to the matter under consideration.

An analysis of the information available concerning the remaining 15 boats was, however, prepared, and, after careful consideration, the committee have agreed that the present system of closing hatchways is satisfactory, but that there should be at least six spare hatch covers for use in emergency. A further important point is that all coal-carrying vessels should be "carefully and properly loaded," while this is stated to be especially necessary in the case of ships which are known to be "tender."

New Southampton Dry Dock

The largest floating dock built in the United Kingdom has been safely berthed at Southampton. The structure has a capacity of 60,000 tons, so that the *Leviathan* or the *Majestic*, the largest vessels afloat, can now be docked in the United Kingdom. The new dock, which is owned by the Southern Railway Company, and has been built on the Tyne by Sir W. G. Armstrong, Whitworth and Company, Ltd., has a length of 966 feet and a working width of 130 feet. The total weight of the dock is approximately 18,800 tons. The sectional form of the structure will permit of self-docking and its length can be added to if that should become necessary in the future through an increase in the size of liners.

"Warehouses and Shipping Rooms" is the title of a safe practice pamphlet just issued from the National Safety Council headquarters, Chicago. "Although warehouses and shipping rooms are not usually looked upon as hazardous places, they have been the scenes of many accidents," the pamphlet states. "These departments involve a large amount of hand labor under changing and often disorderly conditions." The pamphlet treats, in detail, buildings and platforms, hazards of packing materials, hazards of packing, construction of wooden packages, safe practices inside buildings and equipment used in shipping rooms.

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Contrapropeller Fitted to American Steamship Norfolk

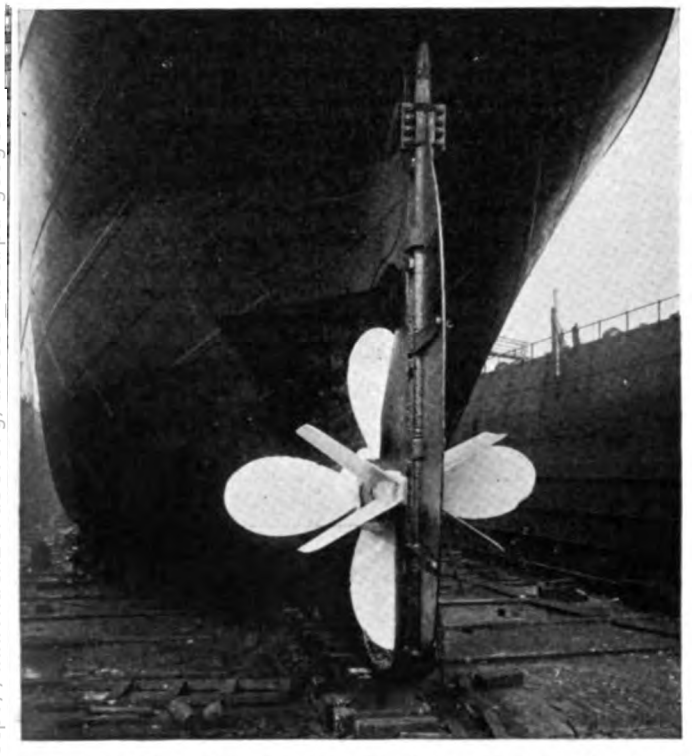
A CONTRAPROPELLER has been attached to the American steamer *Norfolk*, of the Coastwise Transportation Company, to improve her steering and effect fuel economies. This is probably the first installation of this device in an American shipyard. The work was done at the Robins plant, Brooklyn, N. Y., of the Todd Shipyards Corporation.

The *Norfolk* is a single deck collier of 3,521 gross tons, and was built by the New York Shipbuilding Company, Camden, N. J., in 1913.

The main particulars of the ship are as follows:

Length over all	332 feet 1 inch
Length between perpendiculars	319 feet 0 inch
Breadth, molded	48 feet 0 inch
Depth, molded	29 feet 1 inch
Deadweight on 22-foot 4-inch draft	5,300 tons
Engine, 1, triple $\frac{23\frac{1}{4}''-38\frac{1}{4}''-64''}{45''}$	1,750 I. H. P.
Boilers, 2, single-end Scotch—	
Diameter	16 feet 3 inches
Length	11 feet 4 inches
Total heating surface	542,409 feet
Working pressure	180 pounds

The contrapropeller is a device consisting of six blades fitted behind the main propeller. The two vertical arms are of cast steel, and are electrically welded to the stern frame.



Contrapropeller Fitted to S. S. Norfolk at Robins Dry Dock

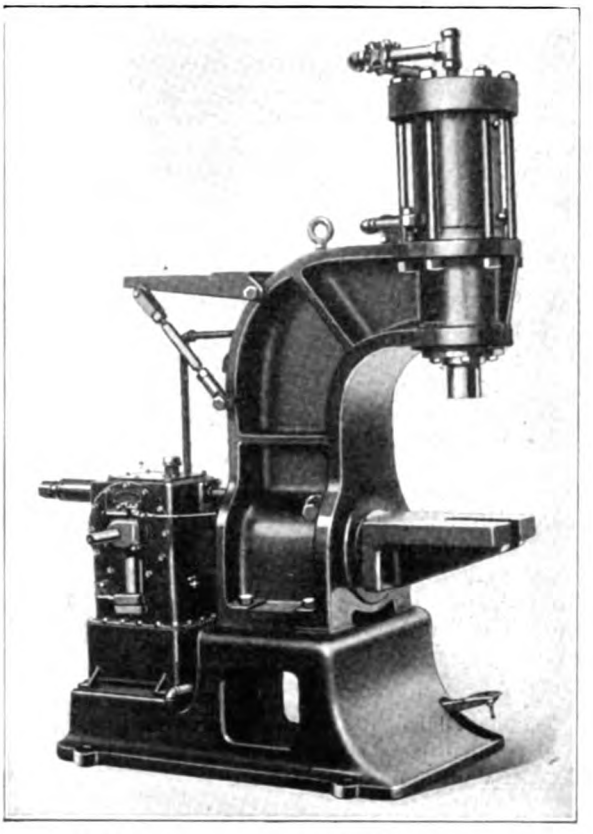
The two center pieces, which include the side blades, are made of cast iron and are secured to the vertical arms by bolts and flanges. The side blades being of cast iron prevent the vessel from being crippled by striking a submerged obstacle. In such an event these blades would break off and not bend so as to foul the main wheel.

Several vessels plying in European waters have been fitted with this device, and under the most severe ice conditions in the Baltic and along the Norwegian coast the contrapropeller has proved serviceable and free from breakage.

Aside from improving the handling of a vessel, it is claimed that the contrapropeller greatly reduces the vibration caused by the main wheel. The revolving propeller of a vessel under way imparts two motions to the water, the axial acceleration and the tangenital velocity of the water. The radial blades of the contrapropeller intercept this turning motion and divert the water into axial acceleration while its absolute speed remains constant. This increased backward thrust is pure gain and serves to increase the speed of the vessel or, inversely, if normal speed is maintained, the fuel consumption is decreased.

Hydraulic Riveter

A NEW riveter of the hydraulic type has recently been developed by The Oilgear Company of Milwaukee, Wis. This riveter, like Oilgear presses and broaching machines, is self-contained, easy to locate anywhere on the shop floor, and may be driven from any constant-speed source of power. Equipped with a type W E Oilgear constant-pressure pump, there is no delay in waiting for pressure to build up, the pressure being available the instant resistance is met.



Self-Contained Oilgear Hydraulic Riveter

The pump furnishes oil to the cylinder under steady pressure, free from pulsations and with instantly variable delivery from zero to maximum, its displacement being positive against any resistance up to the maximum capacity of the machine.

Control by means of a foot treadle allows the operator the use of both hands for the work, the speed of the machine being limited only by the adeptness of the operator in placing rivets.

Setting rivets by this hydraulic method, subjecting each rivet to a quick squeeze, is claimed to be superior in that it allows the metal whether hot or cold to assume its new shape and make a uniform tight joint without undue stresses or fractures. The stroke is 4 inches and the design allows for so

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placing the work that the strokes can be limited so that they will just clear the work on the up stroke or on the return to the ram.

The horn shown in the accompanying illustration is of special design to accommodate an indexing fixture. Removable horns of any design can be used. Standard sizes of this riveter are 10 ton and 20 ton.

Strategical and Tactical Considerations Governing Warship Design*

By Admiral Sir Doveton Sturdee, Bart., G.C.B., K.C.M.G., C.V.O.

THE war does not appear to have reduced the task of the designer—in fact it has materially increased it—added to which the limitation of size imposed by international agreement will not ease his difficulties.

Two new methods of transport have been devised, viz., sub-surface vessels and aircraft. Before considering new designs it appears desirable to determine whether either or both of these types are capable of replacing surface vessels. The answer seems bound to be in the negative, at all events at the present time, whatever the future may have in store.

As this paper concerns warship design, it will not deal with merchant ships beyond calling attention to the risks that these ships are exposed to. Their main defense, as in the late war, will depend on surface warships. Any future trouble is likely to be on the ocean, and would be a repetition of our ocean conflicts of the eighteenth and early nineteenth centuries, for which sea-keeping ships with good radius of action were proved to be essential.

All indications seem to show that the gun will continue to maintain its pre-eminence over all other weapons of offense. The gun will continue to defeat at effective range any armor which it is possible to carry; but it has been shown that armor is essential for the protection of gun positions and vital parts of the hull.

Effective means have been devised to reduce ships' vulnerability from torpedo explosions, and this protection will also serve to protect them from the mining effect of bombs.

Can means be adopted to prevent poisonous gases finding their way into the lower compartments of a ship? The crews are already supplied with gas masks, and I believe the study of the problem is well in hand. However, it may be hoped that the conscience of the civilized world will rise against this abuse of the science of chemistry.

The vulnerability of our battle cruisers to destruction from concentrated gunfire and of our pre-dreadnought battleships to torpedo explosion was shown in the late war. The first appeared to indicate that there was a lack of sufficient appreciation of the effect of plunging fire, and insufficient precautions had been taken to prevent the flash from the bursting of shell reaching the magazine.

When submarines were used for the first time in war, they showed that they could not be used effectively against other submerged vessels. Further, submarines, although excellent for attack, are not suitable for the defense of trade.

Surface war vessels remain essential for the protection of our trade routes.

The ultimate use for a ship of war is in battle. Now let us hope that ships will be designed for that one object.

The war showed the need of better protection from torpedoes. Experience in the war showed that bulges were very effective.

The late war only emphasized our previous war experience: the great need of cruisers. Ample cruiser power is essential for our very existence as an Empire.

Incidentally it may be mentioned that the limited radius of action of aeroplanes reduces their value for ocean warfare, thus rendering them unable to replace the surface cruiser for the protection of our extensive trade routes.

The war showed the value of the submarine for surprise and attack, but their value for defense of surface vessels is small. The introduction of ocean submarines will necessitate some special form of submarine hunter—cruisers of superior gunfire to that of the submarine. The comparatively short range guns our convoying cruisers were armed with in the late war will not now be sufficient.

If competition in submarines is going to become the vogue some of the hoped-for gains from the Washington Agreement will be neutralized.

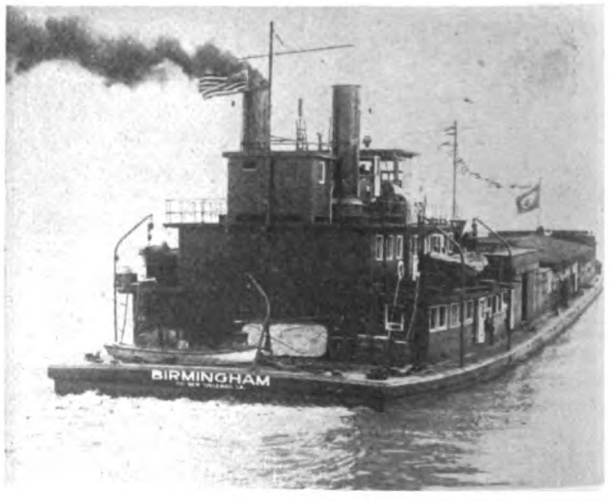
Submarines do possess one undoubted advantage: they are an evident threat to transports attempting to land troops for the invasion of a hostile country.

The late war showed that, so long as ships were under way, air attack is not serious, and there seems no reason to modify this experience. However, defense from the air is essential for ships assembled at a base within air-striking distance of an enemy.

A few lessons may be learned from our experience on the outbreak of war. Many of our cruisers that we were relying on were not efficient for service owing to the frequent postponement of refits. The guns for arming our merchant ships were out of date, no proper reserve having been maintained. An ample reserve of efficient guns and ammunition for these seems to be a necessary insurance for the nation to maintain. With our reduced navy, in the unfortunate event of the outbreak of hostilities a rapid increase of ships of all classes will be the first necessity. This should be anticipated and designs kept up to date for immediate execution.

*From a paper read at the spring meetings of the sixty-fifth session of the Institution of Naval Architects, London, April 9, 1924.

EARTH INDUCTOR COMPASS.—Marked advantages over the usual types of ships' magnetic compasses are claimed for the earth inductor compass invented at the Bureau of Standards, Department of Commerce. During a recent sea test it was found to be free from roll and pitch error to such an extent that it remained steady under conditions which caused the ship's compass to oscillate 2 or 3 degrees.



(Photograph by Kadel & Herbert, N. Y.)

First Barge in New Mississippi River Packet Service Leaves New Orleans for St. Louis

A revival of river packet transportation was inaugurated when the self-propelled barge *Birmingham*, of the Mississippi-Warrier service, left New Orleans on March 30, with a capacity cargo, on her 1,200-mile trip to St. Louis.

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

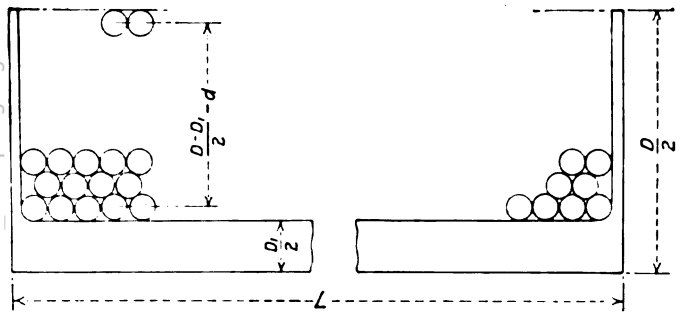
Length of Rope Stowed on Reel

Q. (1,245).—Please give a formula for finding the length of rope or cable towed on a reel.

A. (1,245).—Several formulas are current though they are not in close agreement. The following is used by the American Engineering Company:

$$\text{Length in feet} = \frac{D^2 - D_1^2}{d^2} \times .056\ L \quad \ldots\ldots\ldots\ldots\ldots\ldots (A)$$

Where D = outside diameter of coil in inches.
D_1 = diameter of drum in inches.
d = diameter of rope in inches.
L = length of drum in inches.



Radial Section of Reel

A formula given in Hughes' "Handbook of Ship Calculations, Construction and Operation" reduces to the following when the above notation is adopted.

$$\text{Length in feet} = \frac{D^2 - D_1^2}{4} \times C \times L \quad \ldots\ldots\ldots\ldots\ldots\ldots (B)$$

Where C has the following values:

Size of rope, inches	C	Size of rope, inches	C	Size of rope, inches	C
¼	4.16	1	.262	2	.066
⅜	1.86	1⅛	.207	2⅛	.058
7/16	1.37	1¼	.167	2¼	.052
½	1.05	1⅜	.138	2⅜	.046
9/16	.828	1½	.116	2½	.042
⅝	.672	1⅝	.099		
¾	.465	1¾	.085		
⅞	.342	1⅞	.074		

A comparison of the two formulas shows that if (B) is reduced to the form of (A), the value of C ranges between 0.065 and 0.066.

If the rope is carefully arranged on the reel as indicated in the radial section shown in sketch, it appears that a greater length may be stowed than that given by either of the foregoing formulas.

Using the same notation as before, the length of one inner turn is $\pi (D_1 + d)$ and of one outer turn is $\pi (D - d)$. The mean of these is $\frac{\pi}{2}(D + D_1)$, assuming a uniform increase in the length of each successive round. The difference in diameter of two successive rounds is $2 \times \frac{d}{2} \sqrt{3}$ and the total number of rounds is $\left(\frac{D - D_1}{2} - d\right) \div \frac{d}{2}\sqrt{3} + 1 = \frac{D - D_1 - 2d}{d\sqrt{3}} + 1$. Also, the number of rounds in the inner turn is $\frac{L}{d}$ and in each alternate turn is $\frac{L}{d} - 2$; hence an average number of rounds in each turn is $\frac{L}{d} - 1$. The total length in feet is then, very nearly,

$$\frac{\pi}{24}(D + D_1)\left(\frac{D - D_1 - 2d}{d\sqrt{3}} + 1\right)\left(\frac{L}{d} - 1\right) = \left(\frac{D + D_1}{d^2}\right)[D - D_1 - d(2 - \sqrt{3})](L - d) \times .07757 \ldots (C)$$

Assuming d = ½ inch, D = 28.32 inches, D_1 = 10 inches, L = 24 inches, the numerical values given by equations (A), (B), (C) are 3,774.07 feet, 4,422.74 feet and 4,950.88 feet respectively.

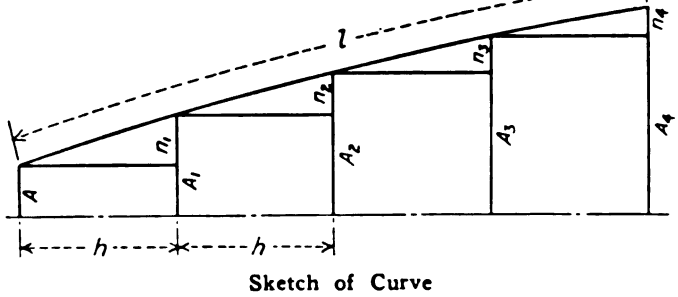
Length of Ship Curve

Q. (1,249).—How do you obtain mathematically the length "1" in the accompanying sketch, when the ordinates A, $A_1 \ldots A_n$ are given for either Simpson's or Tchebycheff's rules. Also, about how accurate is it as applied to ship shapes?

A. (1,249).—The length "1" may be found from the following formula:

$$l = h\sqrt{n_1^2 + n_2^2 + n_3^2 + \ldots n_n^2}$$

The accuracy of the result obtained is dependent upon the number of ordinates and the shape of the curve. If a large



Sketch of Curve

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number of ordinates, say 20, are taken and the curve be long and smooth, like the waterline of a fast passenger steamer, the error between the actual and calculated value of "1" would be very small. With few ordinates, say 5 or 6, and a curve with sudden changes of direction like the midship section contour of an oil tanker, the difference between actual and calculated length might be excessive.

Molded Length

Q. (1,247).—In both Attwood's and Bile's books, the displacement tables show columns midship section coefficient, block coefficient, etc., marked "molded" and "full." Does "molded" mean the length marked "molded" in sketches 1-2 and 3-4 (Fig. 1), or does it include the stem and stern post, or does it mean the length on the load waterline, as shown by sketches 1 and 3?

A. (1,247).—In preparing the lines and body plan for a steel vessel, the molded form is usually shown, that is, the form of the vessel without her shell plating. (This is the form which is later laid off on the scrieve board from which frame molds are taken.) The molded length of this form would be measured between the after side of stem and the

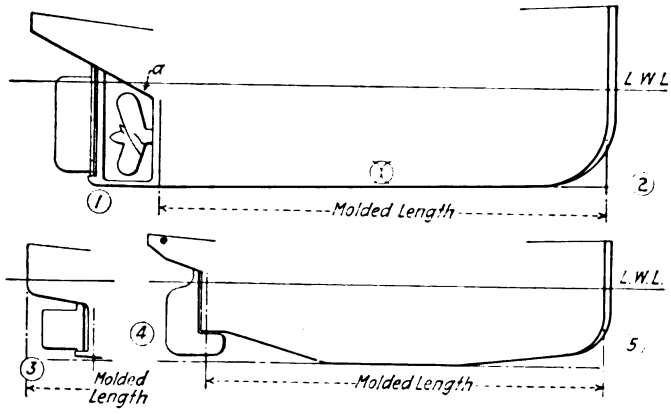

Fig. 1

forward side of stern post (as marked in sketch 4-5, Fig. 1). With a stern as in sketch 3 the molded length would be measured from the after side of stem to the molded line of stern contour at waterline (sketch 3-5). The writer would use a molded length measured from the after side of the stem to the forward side of the propeller post in case 1-2 and in making the displacement calculation consider that the propeller, rudder and wedge (a) at waterline aft of the propeller post were appendages. The coefficients obtained by the use of this length would be more nearly comparable with those of the other types than if the length were measured to the rudder post or to the end of the waterline.

Block Coefficient

Q. (1,248).—It would seem that the block coefficient of types 1-2 and 4-5 (Fig. 1), should be based on breadth times area of immersed middle-line section of ship, instead of LxBxd. Is this assumption correct?

A. (1,248).—The block coefficient can be used to convey only a very general idea of the underbody fulness of a ship. Even where this limitation is recognized it is wise to use this coefficient as a means of comparing vessels of the same type. The following comparison will serve to show what marked differences in form may exist in two vessels having practically the same block coefficient but differing in type and size:

	Battleship	Destroyer
Length, in feet	510	310
Beam, in feet	85	30.25
Draft, in feet	27.5	8
Displacement, in tons	19,000	1185
Block coefficient	.555	.553
Prismatic coefficient	.578	.632
Midship section	.96	.875
Displacement—length coefficient	143.	39.7

Note that the values of the prismatic coefficient differ considerably as do also those of the midship section and the displacement-length coefficients. In other words the forms underbody are entirely dissimilar. This is true in spite of fact that the shape of the central longitudinal plane is dissimilar in the two cases. On these accounts the writer lieves that the refinement suggested would not materi increase the value of this coefficient.

Effect of Adverse Wind or Current on Speed Propelling Turbine

Q. (1,255).—Why does a marine turbine slow down when the going against strong wind or current? In a certain case involving cross compound turbines and double reduction gear capable of tions per minute under ordinary conditions, the revolutions could gotten above 82 or 83 when the ship was being driven against stron or choppy sea.

A. (1,255).—A turbine is designed to develop its mum power at a given number of revolutions and a torque. When winds and waves are adverse or in the ing case when the vessel is moored for a dock trial resistance to the ship's motion is much greater than that templated in the design. The water then flows to the pellers at a slower rate. This has a similar effect upon peller revolutions, *i.e.*, a greater resistance is opposed t turning of the propeller through the water. Therefore designed revolutions cannot be reached and this in t adversely affects the power developed by the machinery. T result is that neither the designed power nor revolutions realized.

Differences in Drawing and Spinning Meta

Q. (1,258).—What are the essential differences in the operations of *ing* and *spinning* metals?

A. (1,258).—The operation known as *drawing* con in successively stamping or pressing a flat sheet of me called a blank, between a progressively varying set of upp and lower dies until the desired shape is obtained. In d drawing, annealing is usually necessary after about t third step in the operation.

Spinning is the operation of shaping metal by press while it is being revolved and is generally an additive operation in order to further change, when desired, the sha or finish of an article after the last step in drawing has be completed. A solid shaping roll having the contour of work and carried on the end of a long spindle is held its the shape while it is rapidly revolved in a spinning lat This roll is small enough in diameter to be easily withdra from the work when the operation is completed. The spi ning is done from the outside by the motion of a burnishi roll mounted on the lathe carriage which presses the metal against the shaping roll as the shape revolves.

Requirements for Life Preservers

Q. (1,259).—The Steamboat Inspection Service Rules require equipment of each lifeboat shall include two life preservers, and elsewhere the rules, that one life preserver shall be provided for each and every on board exclusive of life preservers for children. Is it permissi clude in the latter requirement the life preservers included in the b ment?

A. (1,259).—The two life preservers required as a p of the equipment of each lifeboat are in addition to the nu ber required for passengers and the ship's personnel and to be kept with the lifeboat at all times.

Such a requirement is fully justified by the fact that case of an emergency in which it becomes necessary to res to the use of life preservers a sufficient number should conveniently and immediately available. Again, it m happen, as has often been the case, that many of the have been damaged or lost with their equipment before necessity arises for the use of life preservers.

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LETTERS TO THE EDITORS

Load Factor

Washington, D. C.

TO THE EDITORS:

I have read your most interesting editorial in the April umber on the subject of "Steam." We quite agree that with pplication of a "marine factor" the practices in *marine team engineering* may well profit from the economical sults of the modern central power station.

Referring to paragraph four, you state "the *power* factor f the large New York stations is about 40 percent." We elieve you mean *load* factor instead of power factor; in ther words, the average load is about 40 percent of the aximum load capacity of the station.

L. C. CAMPBELL.

NOTE: The above criticism is quite correct. The average *oad* of the New York power stations is about 40 percent of he maximum capacity.—THE EDITORS.

Securing Fuel Economy at Sea

Brooklyn, N. Y.

TO THE EDITORS:

I have just finished reading that most interesting and instructive article in the April issue on "Securing Fuel Economy at Sea," by Commander H. C. Dinger, U. S. N. The article is full of meat from beginning to end, and it is just exactly what the operating marine engineer needs. The manner of presentation is such that it is easy to follow and understand; also I note there are some new points taken up in the article that are well worth remembering and "stowing away" for future reference.

There is one point, however, that has caused me a little concern, and about which I would like to learn something further. It occurs on page 214, near the top of the left-hand column, and reads like this: "If the temperature is below normal for the pressure carried, it indicates moist steam." As we have been taught to believe that for any given pressure of steam (saturated) there is a definite corresponding temperature, and this, whether the steam is dry saturated or wet saturated, the author's statement as just quoted does not seem to agree.

If the *pressure* in the *boiler* were taken, and, at the same time, the *temperature* in the *main steam pipe* at some distance from the boiler, then it would be fair to assume that these would not correspond. But if pressure and temperature both were taken at the *same time* and at the *same place*, they would correspond according to the respective values given in the steam tables. According to accepted theories relative to steam, this would be true no matter how wet the steam, as long as there is *any* steam at all present.

Therefore I would like to ask if "Reading the thermometer on the main steam line will at once give an indication whether steam is dry or not," which sentence occurs in the same paragraph from which I quoted before.

CHARLES J. MASON.

Philadelphia, Pa.

TO THE EDITORS:

Mr. Mason's point of view is well taken. As a matter of fact the literal statement in my article is not accurate, and I can see where it will create an impression not intended.

If the paragraph in question were rewritten so that the wording between the end of the second sentence and the last sentence should read as follows: "Reading the thermometer on the main steam line will be useful in determining whether steam is slightly superheated (dry) or not. If the temperature is slightly higher than that of saturated steam for the corresponding pressure, this will indicate dry or slightly superheated steam. On the other hand, if the thermometer shows a temperature equal to that of saturated steam or slightly below (the actual thermometer readings are usually a little lower than the actual temperature of the steam), it is an indication of saturated or moist steam. For testing out, the steam can be slightly superheated by throttling down (wire drawing) with boiler stop valve or engine throttle. If a slight wire drawing brings up the temperature of the steam, for corresponding pressure, it will indicate dry steam"—then I think the correct idea would be conveyed.

COMMANDER H. C. DINGER, U. S. N.

Propeller Efficiency vs. Revolutions per Minute

Philadelphia, Pa.

TO THE EDITORS:

The very constructive editorial in the May issue on the subject of Diesel Conversion clearly expresses the general consensus of expert engineering opinion as to the various angles from which the problem must be approached.

It is a significant fact, however, that with regard to the question of propellers for the to-be-converted vessels, the public mind is all made up. The editorial repeats, verbatim, what the present writer had frequently heard from a number of apparently well-meaning men—to increase the rotative speed, say, from 75 to 90 revolutions per minute, would immediately mean decreasing the diameter, and this, in turn, would mean lower efficiency.

It is important to realize that, quite aside of any "opinions" upon this matter, whether "generally accepted" or not, there does not exist any documentary justification of any such thing. On the contrary, there might be a slight gain in efficiency, owing, first to the reduced value of thrust deduction and, next, to the probable greater uniformity of rotation.

The usual reference to the "sea conditions" or to the "service conditions," under which the alleged decrease in efficiency might be noticeable, should not be taken seriously, if we consider the following:

1. Decreased diameter means, if anything, increased minimum tip-submergence—always a good thing to have.

2. Whether the diameter should be cut down in the ratio 16 to 18 is in itself a question. It is quite possible that decrease of diameter would be only slight, and then there would be a certain advantage, in the increased tip clearances.

3. If by "sea conditions" rough weather is meant, it is important to emphasize the fact that tolerably broad blade tips can be designed for the higher speed propeller, which in heavy sea would give just as good an account of themselves as those of another screw turning 15 or 20 revolutions slower.

There would be much less uncertainty in connection with this matter and still less room for mere opinions on this subject (as against actual facts) if we had not been trained, during the past generation, to link the propeller with its horsepower (shaft horsepower) on the one hand, and the ship itself with its own horsepower (effective horsepower) on the other hand, connecting the two with the flimsy link of thrust deduction.

The same sort of a problem can be considered from a somewhat different angle: if a propeller, of certain characteristics as to revolutions per minute and layout, gives a known hull a certain speed (forgetting for the moment all about the horsepower), let us find, in some way, the actual value of the *thrust*, in pounds, experienced by the thrust block. Whether it will be necessary to ask Mr. Kingsbury to design a special adaptation of his bearing for this purpose, or this can be found in some other manner, say by means of computation,

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or both, is another matter, but let us hope that it is not impossible to secure this information. Then, quite regardless of anything else, it is clear that any other screw which will yield the same number of pounds in useful thrust surely will propel the ship at the same speed. And the whole problem will be reduced to the following: *thrust, T (pounds); rotative speed, N (revolutions per minute); power, not to exceed, P (shaft horsepower); required, design of such a propeller.*

The writer would be obliged to anyone who would, in a constructive manner, point out any possible defects in such a viewpoint. But we must deal with facts and measurable quantities first, and form, or accept, general opinions afterward, if we are to get anywhere. This is clear.

N. W. AKIMOFF.

NEW BOOKS

MARINE ENGINEERING PRACTICE. *By Engineer-Commander F. J. Drover. Size, 5⅜ by 8½ inches. Pages 490. New York, 1924: D. Van Nostrand Company.*

Many excellent works on marine engineering, from the designer's point of view, have been published in England—in fact, a majority of the books on this subject have come from there—but there have not been a large number for the special needs and use of the operating engineer. It was, then, with more than ordinary interest that we examined "Marine Engineering Practice."

While we have seldom seen a better printed book, or clearer diagrams and illustrations, and while it contains a large amount of valuable information on many subjects, we have to confess, that, in some ways, the book is a little disappointing. Certain subjects have been treated at length, at the expense of others, equally important; and much, which seems to us of interest to the practical engineer, is virtually omitted, or treated in a very sketchy manner; in other words, the book gives the impression of not being well balanced.

Naturally, the descriptions of various auxiliaries and other similar machinery are practically confined to British makes, and for this reason, the usefulness of the book, on this side of the water, is somewhat restricted.

The treatment of internal combustion engines is confined to well illustrated descriptions of a number of different types. For a practical treatise, there is a surprising lack of information relative to the actual operation of this type of machinery. The author's statement that the auxiliaries for Diesel engines are more economically driven by steam than by electricity will be questioned by many engineers.

The last two chapters are made up of some rather elementary instructions relative to general examination and overhauling, and descriptions of repairs effected by ships' staffs in several instances.

The book contains excellent illustrations of several types of boilers, turbine details, various auxiliaries and a number of Diesel and semi-Diesel engines.

THE DIRECTORY OF SHIPOWNERS, SHIPBUILDERS AND MARINE ENGINEERS, 1924. Twenty-second edition. Compiled under the direction of the editor of *Shipbuilding and Shipping Record.* Size, 5¼ by 8½ inches. Pages, 757. London, S. W. 1., 1924: The Directory Publishing Company, Ltd.

This directory furnishes particulars of all the leading steamship companies, shipbuilders, ship repairers and marine engineering works throughout the world. It also gives the names of the directors and principal officials, and details of the fleets owned by the shipping companies. A supplementary section includes a list of societies, institutions, and labor federations, and a directory of consulting marine engineers and naval architects. At the end of the volume are exhaustive indexes containing some 24,000 entries.

TESTS OF MARINE BOILERS. By Henry Kreisinger, John B. A. R. Mumford, B. J. Cross, W. R. Argyle and E. Sherman. Size, 5¾ by 9⅛ inches. Pages, 309. Illustrated 165. Washington, D. C., 1924: Bureau of Mines, Department of the Interior.

The material presented in this bulletin is divided into main parts. Part I contains the results of thorough evaporative tests of three watertube boilers, designed for the United States Shipping Board Fleet Corporation. Two of the a three-pass and a four-pass boiler with horizontal baffles were designed primarily for wooden ships. The third is a novel arrangement of horizontal baffles and a superheater and was designed for steel ships.

Part II contains the results of a series of steaming tests of a Scotch marine boiler burning hand-fired coal, pulverized coal and oil. The tests were made by the United States Shipping Board in cooperation with the Bureau of Mines and the results enable the thermal efficiencies of the watertube and Scotch boilers to be compared.

Copies of the bulletin can be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C.

Sperry Gyroscope Company Offers Prizes for Title of Picture

THE Sperry Gyroscope Company, Brooklyn, N. Y., has just announced a cash prize contest for the seagoing personnel of the navies and merchant service of the world in order to obtain a title for a picture showing the Sperry gyro-pilot, familiarly known to seagoing men as "Metal Mike," connected to the steering wheel and automatically steering a vessel at sea; with the deck officer standing at the forward part of the pilot house on lookout. A phantom of the traditional quartermaster is standing at the wheel. A title such as "The Traditional Helmsman Superceded," "Today and Yesterday," is desired. The title must not exceed seven words or thirty-five letters. The shorter titles will receive more consideration.

The contest opens June 1 and closes August 31. Prizes range from $100 for first prize, down to $5. The contest is limited to seagoing personnel (this includes the Great Lakes of North America) of the navies and merchant services of the world and seagoing personnel on land duty.

Mr. T. H. Rossbottom, general manager of the United States Lines, New York; Mr. J. L. Luckenbach, vice-president of the Luckenbach Steamship Company, New York, and Captain D. S. Miller, marine superintendent of The Cunard Steamship Company, Ltd., New York, will act as judges.

NEW MATSON LINER.—Announcement has been made by the Matson Navigation Company, that it has decided to build a $6,000,000 express liner for direct passenger service between San Francisco and Honolulu. The ship will carry 500 first-cabin passengers, and with its speed of 21 knots will make the voyage between San Francisco and Honolulu in four and a half days. Two trips a month will be made against one by the line's present fastest steamers. The dimensions of the vessel are: Length, 578 feet; breadth, 75 feet; displacement, 17,500 tons. Propulsion will be by turbo-electric machinery rated at 24,000 horsepower. Electricity is to be used throughout the ship for all auxiliary purposes including the preparation of foods.

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PERSONAL MENTION

M. T. NOBLETT, manager of United American Line's ntercoastal service has been chosen chairman of the Atlantic Intercoastal Conference, succeeding John McAuliffe, Jr.

JOHN STRACHAN, formerly general superintendent of the Hog Island shipyard, has been appointed operating manager of the Black Diamond Lines from the Atlantic coast of the United States to Rotterdam and Antwerp.

WILLIAM A. LAKE, who has been connected with the Pantasote Company, New York, for the past 15 years, has been appointed sales manager of its marine and railroad department, for the disposition of all Pantasote and Agasote products in those fields. Mr. Lake entered service of the Pantasote Company in its sales department on April 1, 1909, and was given charge of the entire marine and railroad fields, for the territory composed of the southern, the middle states, a few of the western states and the Island of Cuba. In the marine field Mr. Lake has built up a very large business for the Pantasote Company.

W. A. Lake

J. HERBERT TODD, son of William H. Todd, president of the Todd Shipyards Corporation, New York, has been made president of Clinton Dry Docks, Inc., Brooklyn, N. Y., one of the Todd subsidiary companies, with Joseph Haag, vice-president.

JAMES A. CAPSTAFF, who, for a number of years, has had charge of the turbine work of the W. & A. Fletcher Company, Hoboken, N. J., has recently left the employ of that company and organized the Capstaff-Hunter Turbine Works, Inc., of Hoboken, N. J. Before coming to this country, Mr. Capstaff had had an unusually thorough training and experience in the design and construction of steam turbines. After 8½ years spent in the various departments of the Parsons Turbine Company at Newcastle, he was, for over four years, employed at the Vickers works at Barrow on turbine design. During this period, the Vickers Company built the turbines for several British battleships, as well as for the battle cruisers *Lion* and *Princess Royal*, and also for a number of foreign warships. After coming to this country, Mr. Capstaff was employed, for two years, in the engineering department of the New York Shipbuilding Company, and later by the Fletcher Company. For the past several years he has had entire charge of the turbine work of the Hoboken concern. Elsewhere in this issue, mention is made of the new company, of which Mr. Capstaff has become the head.

J. A. Capstaff

GEORGE J. ROBINSON, for many years vice-president of the Robins Dry Dock & Repair Company, Brooklyn, N. Y., has been appointed president of the company. Mr. Robinson was born in Brooklyn in 1870 and has been identified with ship construction and repair all his life. He started in as a passer boy for the old firm of Hendren & Robins, now the Robins Dry Dock & Repair Company, and advanced steadily to the positions of leading man, foreman, assistant superintendent, superintendent, general manager, vice-president and now president of the company. The Robins company is one of the subsidiaries of the Todd Shipyards Corporation, of which William H. Todd is president. Mr. Todd was also president of the Robins plant until his recent retirement from that office permitted the advancement of his old friend and associate. When Mr. Robinson became president of the yard, George Dawe and Frank Gilbride, superintendents at the plant, were made vice-presidents and William J. Robinson, son of the new president, was appointed superintendent.

G. J. Robinson

SAMUEL AITKEN, consulting marine engineer, has been elected vice-president of Moore & McCormack Company, Inc., 5 Broadway, New York City. Mr. Aitken is widely known in the marine field on the Atlantic and Pacific coasts, as well as abroad. As a young man he served his apprenticeship in shipbuilding and engineering with Harlan & Wolff, Belfast, Ireland, later going with the White Star Line and then with the Pacific Mail Steamship Company, as chief engineer. While on the Pacific coast he became connected with the Moore & Scott Iron Works at San Francisco. At the beginning of the war, he was made assistant to the United States Shipping Board representative in the Far East, repairing interned enemy ships and sending them to the States. Later Mr. Aitken was with the United States Shipping Board in New York, as engineer representative on the Board of Inspection, after which he became port engineer of the North Atlantic district of the board, leaving this position five years ago to become superintending engineer for Moore & McCormack. In 1920, Mr. Aitken started in business for himself, as a consulting engineer, taking care of the ships of the Union Oil Company of Delaware and the Equity Steamship Company, and those operated by Messrs. Moore & McCormack. Mr. Aitken plans to continue his practice as consulting engineer, in addition to his new duties as vice-president of the Moore & McCormack Company.

Samuel Aitken

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The Month's Shipping and Shipbuilding News in Brie

Shipyard, Steamship and Port Activities and Other Notes of Interest in All Branches of the Marine Industries

New Porto Rico Liner

THE New York and Porto Rico line is asking for prices on a new passenger and freight ship, it is learned, with a view to the building of a vessel larger than that proposed last year. Bids were received on March 20th, 1923, for a 428-foot ship, of the 3 deck hurricane deck coastwise type, propelled by Parson's design turbine engines and designed by Theodore E. Ferris, naval architect and marine engineer, of 30 Church Street, New York.

It is understood that the data from which shipyards are now preparing estimates, provides for a ship having an approximate length of about 450 feet and costing about $2,600,000. She will probably be propelled by turbine engines, steam being supplied by Scotch boilers, burning oil for fuel, the cargo space being refrigerated for the carrying of citrus fruits, and the steamer to accommodate over 300 first class passengers, plus a specified number of second class accommodations.

Bids Opened on May 26 for the Construction of Six New York Ferries Costing Over Million and a Ha

PROPOSALS for the construction of six steel ferry boats for the City of New York were received by the Commissioner of Plant and Structures, Municipal Building, until 2 P. M. on Monday, May 26th. It is believed the boats will cost a total of over one and one-half million dollars.

The vessels are to be double-ended ferries, each having three driveways for vehicles and two cabins for passengers on the main deck. The hulls will be divided into seven watertight compartments. The boats are to be built under the special survey of the American Bureau of Shipping, and are to have a length over guards of 151 feet; length outside end posts, 148 feet; breadth over guards, 53 feet; breadth of hull, molded, 37 feet 6 inches; depth from base line to top of beams at center of boat amidships, 15 feet.

Machinery

The contractor is to furnish and install main steam engines, boilers, auxiliaries, piping, shafting and equipment complete; the main propelling engines to consist of vertical direct acting, fore and aft pound engines, coupled together. The ders are to be 12 inches and 26 inches eter by 18 inches stroke, the engines designed throughout for a steam pr of 200 pounds at the throttle and maximum piston speed of 600 feet per ute.

Boilers

Each boat is to be equipped w watertube boilers each having an eff heating surface of not less than 1,350 s feet, the boiler to be built for a w pressure of 225 pounds per square inc fitted for burning oil fuel. The boil to be equipped with soot blowers o proved make and type.

A complete oil burning system fo boilers is to be installed, the system t prise two fuel tanks, duplicate fue pumps and strainers, four air register mechanical burners, forced draft blowe equipment for starting fires, together the necessary piping, valves and fittings

Propellers and Pumps

The propellers are to be of solid blade type, made of open hearth cas about 82 inches in diameter. For eac there is to be one two-pass condens dependent of the main engine hav cooling surface of 1,200 square feet, sured on the outside of tubes. The c lating pumps are to be of the centri type, having sufficient capacity to fur 900 gallons of water per minute at n engine speed, the pumps to be direct nected to a 6-inch by 6-inch vertical oiling engine. The pumps and engine to be of approved make. Other p equipment will include for each boi air pump of the vertical beam type, ha one steam cylinder and two air cylinder 8 inches by 14 inches by 12 inches; t vertical simplex feed pumps, 7½ inche 5 inches by 16 inches, suitable for a w ing pressure of 300 pounds per square in one horizontal duplex fire pump 9 in by 6 inches by 10 inches, and one ver simplex bilge pump, 6 inches by 10 inc A feed water heater is to be installed Griscom-Russell, Row and Davis, Ber hem, or other approved make of suffic capacity to heat 16,000 pounds of water hour from 110 degrees to 212 degrees with 5 pounds back pressure.

Contract for $800,000 Steel, Steam Driven Car Ferry Awarded Manitowoc Shipyard by Ann Arbor Boat Company

A CONTRACT for the construction of "Car Ferry No. 7," a steel twin screw steamer, has been awarded the Manitowoc Shipbuilding Company, of Manitowoc, Wisc., by the Ann Arbor Boat Company, a subsidiary of the Ann Arbor Railroad Company, 42 Broadway, New York City. It is understood that the vessel will cost close to $800,000.

The steamer will have a length overall of 360 feet, length between perpendiculars 346 feet, beam 56 feet, depth to main deck 21 feet 6 inches, draft (maximum mean loaded) 16 feet. Propulsion will be by reciprocating engines. The vessel will have a capacity of 30 standard freight cars, four tracks being located on the main deck. The cabin arrangements are to be for the accommodation of a crew of 46 men, with passenger accommodations consisting of 12 staterooms, each stateroom to be fitted with double berths. The ferry is to be constructed with a single bottom hull, with seven watertight bulkheads, there being two steel masts.

Propelling Machinery

The propelling machinery will consist of two vertical, triple expansion, direct acting, jet condensing engines connected to outboard turning propellers. The cylinders will be 20½ inches by 34 inches by 56 inches with piston stroke of 36 inches. Steam will be supplied by four Scotch boilers 14 feet 6 inches inside diameter, with a length of 11 feet, burning coal for fuel under the Howden system of forced draft. Each boiler will contain three Morison type corrugated interchangeable furnaces 42 inches inside diameter and 432 tubes of seamless steel. The boilers are to have a working pressure of 185 pounds per square inch, the engines turning two 4-bladed propellers.

Engineroom Equipment

The engineroom equipment will include two feed pumps of the horizontal duplex outside end packed plungers of pot valve type, with steam cylinders 10 inches in diameter and plungers six inches in diameter by 12 inch stroke, having a working pressure of 300 pounds per square inch; one Reilly No. 18 two-pass marine type feedwater heater, capable of raising the temperature of the entire feed water from 100 to 210 degrees F., with a steam pressure of five pounds per square inch. The air pumps and condensers are to be of the independent type with jet condenser common to both main engines and two vertical air pumps, each driven direct by steam cylinders. They are to be of approved make of sufficient capacity to maintain a constant vacuum in the condenser of 24 inches.

The vessel will be handled by a steam steering gear of approved make and will be heated throughout by steam.

Ferryboat Awarded

The Canulette Ship Building Corp Inc., of Slidall, La., was awarded the c tract for a ferryboat to be used on L Pontchartrain, La., from J. B. and F Comfort, New Orleans, La., at a price $65,000. The boat will be equipped w 300-horsepower Diesel engines.

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gulations Proposed for Safeguarding Use of Internal Combustion Engines

ENTATIVE regulations for safeguarding the use of internal combustion engines in marine practice represents additional accomplishment of the Marine mmittee of the National Fire Protection sociation, which made a report to the assotion at its May convention in Atlantic y. Under the competent direction of nuel D. McComb of the Association of rine Underwriters who assumed the irmanship in 1919, this committee has idly advanced to a position of equality in uence with the most important committees the association, and is successfully deloping its plan for preparing regulations all phases of marine work.

harleston to Take Over Army Supply Base

According to announcement received, an reement has been reached by H. M. llagher, General Manager of the Charles-n Port Terminal, with Solicitor Nicholson the Shipping Board at Washington, rela-e to final details in the taking over of e giant army supply base at North harleston, by the municipal operated Port ilities Commission, and only a few adstments are required before the permant lease will be entered into between the ty of Charleston and the United States ipping Board.

ipper Dredge Bids To Be Taken After July 1

The bids for two steel hull dipper dredges Louisville Engineer District will not be ened until after July 1st, according to formation received, as they are not yet ady to be issued. The dredges are to be feet by 36 feet by 120 feet, and are to have ur yard dippers. The main hoisting enes will be 13 inches by 16 inches. Each edge will have six 15-inch steel spuds.

ontract for New Matson Liners Expected Soon

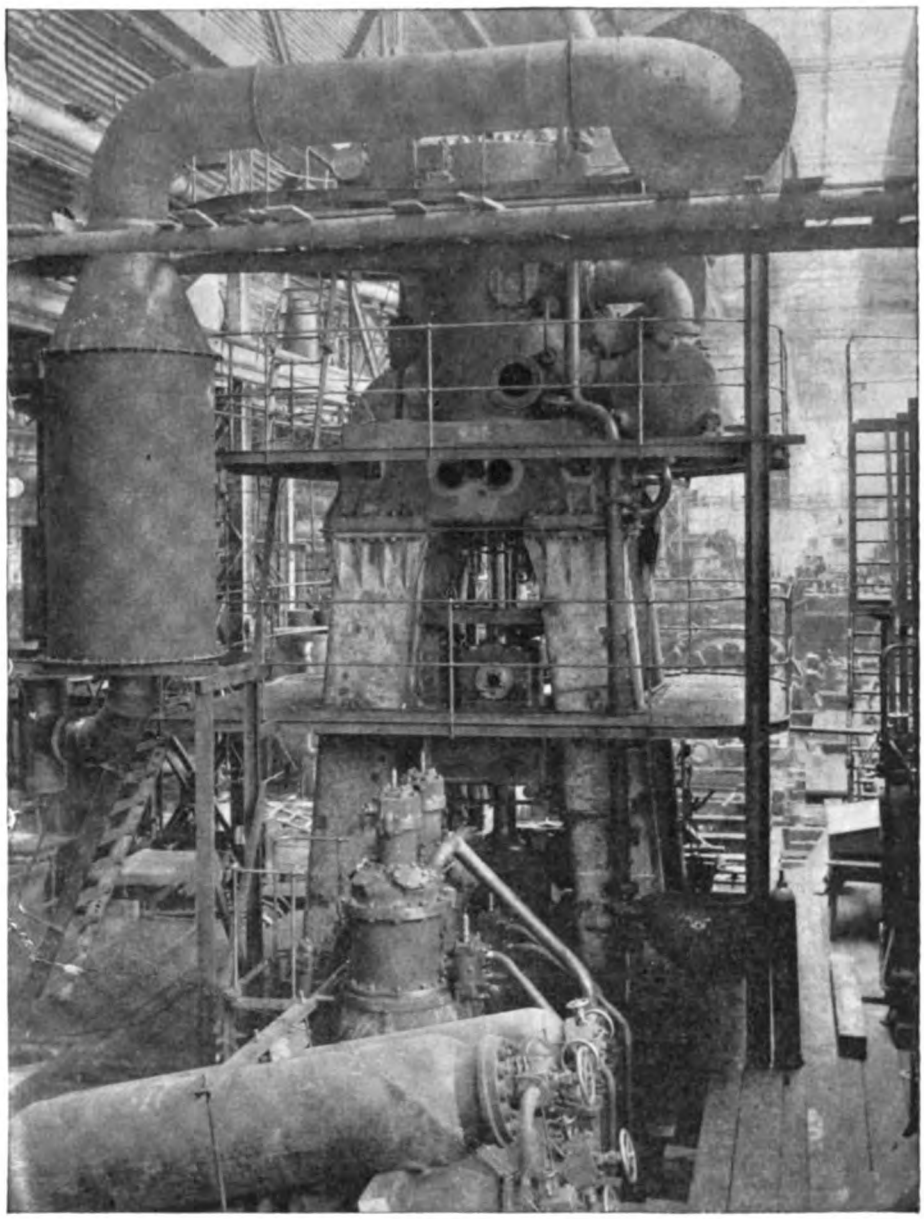
Announcement is expected in the near ture of the award of a contract for one two passenger steamers of the Matson ine for West Coast service. It is underood that shipyards have been working n plans and specifications for some time ast and an early decision is anticipated.

Winch and Capstans

Announcement has been made by the Brith Vice Consul at Montevideo that tenrs will be received until June 17th, 3 M., for the supply, delivery and erection one electric winch, capable of hauling oats of 600 metric tons, and two electric apstans of a hauling capacity of 8 metric ns at a circumferential speed of 10 to 15 eters per minute.

New West Coast Terminal

The Pacific Steamship Terminal Company f Seattle voted $1,500,000 first mortgage per cent serial gold bonds, for the conruction of the first unit in the improvement of water front terminals, which ill involve an estimated expenditure of 4,000,000.



Single Cylinder, Two Cycle, Double Acting Experimental Engine of 1000 Brake Horsepower Under Test in M. A. N. Shops

A New-Comer in the American Diesel Field

THE Hooven, Owens, Rentschler Company of Hamilton, O., has taken out a shop license for the construction of stationary and marine Diesel engines of the M. A. N. type.

The Hamilton company has been building steam engines since 1845, and in the days of slow speed engines, the Hamilton-Corliss was known throughout this country. During the late war, this company went into quantity production of marine engines for the U. S. Shipping Board, turning out approximately 140 engines ranging in size from 750 to 2,800 indicated horsepower. They have also built a large number of engines for private concerns and in 1921 produced a greater horsepower of marine engines than any other plant in the world.

The M. A. N. Company is one of the largest builders of engines and heavy machinery. They were literally the first builders of Diesels as Dr. Diesel's first experimental engine was constructed by them. They have recently developed a two cycle, double acting engine and the illustration shows a single cylinder experimental engine of this type, which develops from 1,000 to 1,200 brake horsepower at from 90 to 110 revolutions per minute.

The production of large M. A. N. Diesels by an American concern will be awaited with great interest.

Steel Scows

The United States Engineer Office, Pittsburgh, Pa., will receive bids until 12 o'clock, Eastern Time, on June 18th for furnishing and delivering two steel dump scows, each having a molded length of 100 feet, molded beam 26 feet and molded depth 5 feet 10 inches.

To Build Machine Shop

The Howard Shipyards, Jeffersonville, Ind., is contemplating building a new machine shop, 55 feet by 300 feet. All machinery, including 10-ton crane, will be electrically driven.

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Atlantic Coast Shipbuilders' Association Holds Seventh Annual Meeting

DEFINITE steps were taken by the Atlantic Coast Shipbuilders' Association at its seventh annual meeting in Philadelphia on May 12 to place before the shipbuilding industry of the entire country a constructive plan of action that will conserve American shipyards as an important factor in the development of the American merchant marine.

Realizing that the surest safeguard against forces inimical to the best interests of shipbuilders of the United States is a vital and aggressive organization keyed up at all times for action in the defense of a great and basic maritime industry, the association members expressed strong approval of plans submitted for further expansion of the activities of the organization to include shipyards on the Great Lakes and the Pacific coast.

A patriotic appeal was made to American business men to give their enthusiastic support to the industry through placing construction and repair contracts in American shipyards, and in favoring American flag ships in the routing of foreign shipments.

Shipyards Lack Orders

President Magoun, pointed out the vastly increased shipbuilding facilities of the nation since before the war and the proportionately less business at the present time and said he could not recall a time when there was less marine work in the yards, and deplored the apathy to this condition of people other than shipbuilders who will be seriously affected if the industry is not conserved. He added that unless the remedy for these conditions is speedily found the country will again be confronted with the situation which prevailed at the outbreak of the war.

H. G. Smith, vice-president of the Bethlehem Shipbuilding Corporation, referred to the pending Dieselization bill as the most direct present step now before Congress that will benefit the shipbuilding industry and further the American merchant marine. He mentioned that there is also destructive legislation pending in Washington, notably the amendments to the Naval Appropriation bill and to the Independent Offices Appropriation bill which would make it mandatory for the government to have all vessels constructed or repaired in the navy yards, thus preventing the Navy Department and the Shipping Board from having such work done under competitive conditions and making it impossible for the government to take advantage of the experience and trustworthiness of the private yards.

Robert Haig, vice-president of the Sun Shipbuilding & Dry Dock Company, showed how the public as well as the private shipyards suffer when contracts are gobbled up by the government establishments, which he said are largely supported by taxation collected from the public, and the increased cost of work done in the navy yards must come out of the taxpayers' pockets.

E. B. Hill, vice-president of the Bethlehem Shipbuilding Corporation, discussed the disastrous effects upon American shipbuilding of the naval disarmament conference and its supposed 5-5-3 ratio. He showed how Great Britain scrapped from the bottom up while the United States scrapped from the top down, and he pointed out the need of this country for more naval vessels of certain types.

L. H. Korndorff, vice-president and general manager of the Federal Shipbuilding Company expressed the opinion that the present situation called for intensive development of opportunities that lie close at hand rather than seek those far afield. A suggestion made by Mr. Korndorff which is now being given serious consideration by the governing body of the association is that a committee be appointed at once to confer with Secretary of Commerce Hoover for the purpose of properly presenting the facts pertaining to the shipbuilding industry for consideration in connection with the deliberations of the group appointed by President Coolidge with Mr. Hoover as chairman to study the American merchant marine problems and make such recommendations as appear in order.

A number of other gentlemen, prominently connected with the shipbuilding industry, spoke at length on various matters of particular interest to the members of the association, among them being Messrs. J. K. Graham, H. F. Norton, W. A. Dobson, W. G. Coxe and C. S. King.

Officers Reelected

Harry A. Magoun, senior vice-president of the New York Shipbuilding Corporation, Camden, N. J., was reelected president of the association, Charles P. Wetherbee, engineering director of the Bath Iron Works, Bath, Maine, was reelected vice-president, and J. Harry Mull, president and general manager of the William Cramp & Sons Ship and Engine Building Company, Philadelphia, was reelected treasurer. Clarence Samuel King, who has been identified with the association since its inception, was reelected secretary.

Gulf Refining to Build New Wharf at Charleston

The Gulf Refining Company of Charleston has received a permit for the construction of a wharf and for extensive dredging in Shipyard Creek, in connection with the large storage distribution plant which the company is building at Charleston.

The wharf is to be 1,000 feet long. Dredging is to be from the Cooper River channel up to the Shipyard Creek, for a distance of from two-thirds to three-quarters of a mile. The channel is to be 28 feet deep, and will vary in width from 100 to ... feet. The material dug up in the dredging operations, it is expected, will be deposited into the marshland for filling.

Eight Million Dollar Diesel Electric Fleet Proposed

CONSTRUCTION of a fleet of eighteen to twenty Diesel-electric ... boats, having an estimated total cost approximately $8,000,000, for service between Chicago and New York and at sea, is the latest proposed building program attracting attention in the marine field. It is reported that New York and Western shipping interests are likely to put the project through and that the vessels have been designed by Theodore D. Wells, naval architect and marine engineer of 11 Broadway, New York.

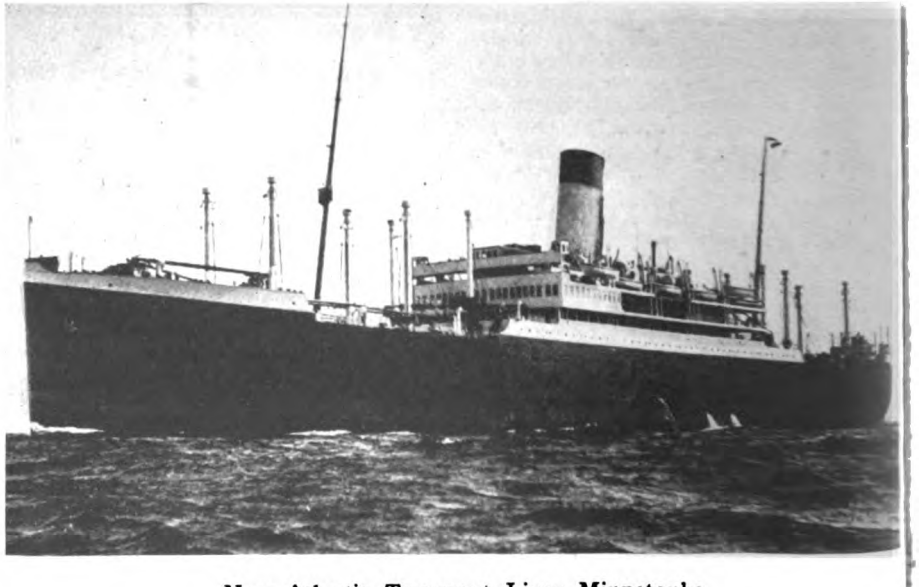
According to exclusive information obtained by *Marine Engineering and Shipping Age*, the proposed vessels will be about ... feet in length, with a molded beam of ... feet and a depth of 18 feet. There will be two propelling motors located aft, driving twin screws, four generating sets being located amidships. The boats will be built of steel and constructed to receive the highest rating of the American Bureau of Shipping under special survey.

S. S. Minnetonka Added to Atlantic Transport Fleet

COMPLETING her maiden voyage from London to New York on May ... the new Atlantic Transport liner *Minnetonka*, of 21,998 tons, a sister ship to the *Minnewaska*, which was illustrated and described in our October, 1923, issue, represents the latest features of construction in a large combination freight and passenger carrier.

The new liner, which is 625 feet long, ... feet beam and 53 feet 6 inches depth, is ... tons larger than her predecessor, and with her will maintain a schedule of fortnightly sailings out of New York. The two vessels carry first-class passengers only.

Propulsion of the new liner is by a twin screw arrangement of Brown-Curtis single reduction geared turbines supplied with steam at 215 pounds per square inch and 100 degrees F. superheat by twelve oil-fired watertube boilers.



New Atlantic Transport Liner Minnetonka

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Spring Banquet of American Marine Association at Waldorf-Astoria Hotel, New York, May 15

merican Marine Association Holds Spring Get-Together Meeting and Banquet: To Frame Shipping Policy

AT the meeting of the American Marine Congress, held at the Waldorf-Astoria hotel, New York, on Thursday afternoon, May 15, at which Stevenson Taylor, president of the American Bureau of Shipping, presided, the following resolutions were unanimously adopted:

RESOLVED, by the American Marine Congress that we reiterate our deep conviction that the Nation can never be safe or its trade and industry genuinely prosperous until the promise of the Merchant Marine Act, 1920, is realized and the United States has "a merchant marine of the best equipped and most suitable types of vessels sufficient to carry the greater portion of its commerce and serve as a naval or military auxiliary in time of war or national emergency, ultimately to be owned and operated privately by citizens of the United States";

RESOLVED, that we applaud the action of the President of the United States in constituting two great committees, including members of his cabinet, to consider and recommend just and vigorous means by which the merchant marine may be assured of a permanent strength commensurate with the needs of our country in peace or war;

RESOLVED, that a representative committee of this Congress be appointed by the president of the American Marine Association to draw up a concise and constructive merchant shipping policy, and to urge the great political parties to write such a policy in their national platforms;

RESOLVED, that meanwhile all American citizens and particularly merchants, manufacturers, shippers and railroads should freely, on their own initiative, give such a fixed, voluntary preference in employment to American ships, that idle fleets may vanish from our waters and that keels may again be laid in our shipyards of new vessels of improved design, worthy of the best maritime traditions of America;

RESOLVED, that the American Marine Congress entertain suggestions from all classes of American activities having as their objective the creation of conditions favoring American shipping development, internal and external, or the removal of existing conditions that hamper such development.

Banquet at the Waldorf

In the evening of May 15 the spring banquet of the American Marine Association was held at the Waldorf Astoria Hotel. Emmett J. McCormack, of the Moore and McCormack Steamship Company, was toastmaster and the speakers included Hon. Curtis D. Wilbur, Secretary of the Navy, Rear Admiral Leigh C. Palmer, president of the United States Shipping Board Fleet Corporation, Congressman George W. Edmonds, vice-chairman of the House Committee on Merchant Marine and Fisheries, and Bert E. Haney, member of the Shipping Board from Oregon.

Secretary Wilbur pointed out that not only is an American merchant marine vital to the essential commerce of our nation, and hence to the prosperity of our people, but also that it is an essential part of our national defense. The Navy and the merchant marine are interdependent, he declared.

Rear Admiral Palmer urged all American shippers and travelers to patronize American ships. Our services, he said, are now such that travelers abroad need not be appealed to on the score of patriotism, for our services are the best in the world.

On every overseas trade route of any considerable importance to American commerce there are American services, either privately or government owned. The comparatively few privately-owned services appear to be well established. The more numerous Government lines are in various states of being, ranging from heavily losing pioneer lines to well-established, almost self-supporting services. The cargo services as a whole are at present losing on the average about $25,000 per ship per voyage.

We must contemplate replacing steamers with motorships on certain of our services where the change will be economically justified. By the conversion of steamers which have suitable hulls but poor machinery, we can obtain at reasonable cost a very considerable number of motorships which will be essentially new vessels. This should not all be done at once, but the program should be spread over a considerable period, and the work carried on in a progressive and orderly manner.

Congressman Edmonds declared that the merchant marine had been destroyed by the indifference of the people and that it will take years to make up for the golden opportunity lost by the killing of the subsidy bill last year. The real available aid to American shipping contained in the Jones Act is the application of Section 28 which at present lacks the machinery to put it into operation.

There are three great legislative measures which should have the attention of Congress, he said. The first is to pass a bill containing the aids outside the subsidy but embodied in the subsidy bill. Second, the revision of the navigation laws should be completed. Third, the Shipping Board should be divorced as nearly as practicable from the Fleet Corporation.

Commissioner Bert E. Haney, of the Shipping Board, pointed out that unless Congress sees fit to furnish additional indirect aids to the Government-owned fleet, it must, under existing conditions, inevitably operate at a loss. This loss, however, can be minimized, provided there are in America a sufficient number of shippers and business men who desire an American merchant marine, sufficiently, to help it. Without the necessary aids to enable them to compete on anything like even terms with foreign shipping, private American citizens cannot afford to go into shipping.

We cannot have a merchant marine of our own unless we emulate our rivals and see to it that our merchant marine receives the support and backing it deserves. I see no way to develop our American merchant marine under present laws, through which the private American shipowner is handicapped, except by continued Congressional appropriations. Congress has not yet indicated an unwillingness to meet the deficit incurred in keeping our merchant fleet in operation. But we cannot hope that without the support of the business interests of the country this attitude will be maintained.

The present outlook for world shipping is hopeful. Apparently there will be an increase in rates which will help lessen this deficit. We must have the same support from our shippers that foreign nationals give their ships.

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Four New Vessels Awarded Bethlehem Plant, West Coast

CONTRACTS for the construction of four new vessels—three modern ferries and one passenger and freight steamer—having an estimated total cost of approximately $2,500,000, have been awarded to the Bethlehem Shipbuilding Corporation, San Francisco, Calif. The ferries are for the San Francisco and Richmond Transportation Company, of which J. B. Thomas, cashier of James Rolph Company, is president, and the fourth vessel is for the Hawaii Meat Company of Honolulu.

The ferries will be built of steel, having a length of 246 feet, beam 60 feet 6 inches and depth 19 feet 3 inches. They will be driven by reciprocating engines of about 1,500 indicated horsepower, steam being supplied by watertube boilers. The boats will be modern in every detail and will have a carrying capacity of about 80 automobiles.

The combination freight and passenger steamer for the Hawaii Meat Company will have a length of 210 feet, beam 36 feet, depth 16 feet, with a deadweight capacity of 1,100 tons and speed of 13 knots.

Capstaff-Hunter Turbine Works Established in Hoboken, N. J.

THE Capstaff-Hunter Turbine Works has recently been incorporated at Hoboken, N. J., with Jas. A. Capstaff president and David Hunter vice-president. The new company has taken over the old established shops of the Hunter Machine Works and is thoroughly refitting them to undertake the building and repair of steam turbines as well as for a general repair shop business.

Mr. Capstaff is well known among shipbuilders and operators as an expert in turbine design and construction, while Mr. Hunter, the son of the founder of the original company, has had a long experience in general machine shop work.

Will Undertake General Engine Work

The new company proposes to undertake marine engine work of all description, and to this end has leased a pier on North River for the accommodation of vessels undergoing repairs and overhauling.

Shipyards Suffer Fire Damage

Fires damaged two buildings of the Federal Shipbuilding & Dry Dock Company's plant at Kearney, N. J., to the extent of about $300,000 total. About 9 P. M. last Sunday, flames burst from the building in which the mold loft and joiner shop were located on the second floor above the plate shop and rapidly destroyed the roof and second floor. On Monday at almost the same hour, another fire slightly damaged part of the roof of the machine shop before firemen gained control. The cause of both fires is unknown.

The damaged facilities will be replaced as rapidly as possible and the work of departments affected has been transferred, pending such repairs, to other facilities available in the plant.

Fire broke out in the Charles W. Morse Shipyard, Noank, Conn., on May 19th. Five buildings, two houses, one government tug, the *General Richard Arnold*, and two wooden hulls of the Ferris type were burned. A third hull and the machine shop were saved. The loss is estimated at about $150,000.

Patrol Boat Bids

Bids and estimates for the construction of one hundred and seventy-five 75-foot patrol [illegible] (described in this bulletin of April 26th) for the United States Coast Guard on May 19th

Name of Bidder	Number of Boats	Price Per Boat	Approx. Work
I. H. Larsen, Marinette, Wis.	10	$18,800.00	60 days
Mathis Yacht Building Co., Camden, N. J.	10	18,372.00	4 mo.
	15	18,675.00	
	25	18,425.00	
Andrew Berg, Seattle, Wash.	10	19,700.00	90 days
Jakobson & Peterson, Inc., Brooklyn, N. Y.	10	20,600.00	80 days
DeFoe Boat & Motor Works, Bay City, Mich.	10	21,000.00	
	15	20,375.00	
	25	19,800.00	25 days
Crowninshield Shipbuilding Co., Fall River, Mass.	10	21,450.00	80 days
Dachel-Carter Boat Co., Benton Harbor, Mich.	10	21,950.00	
Lake Union Dry Dock & Machine Works, Seattle, Wash.	35	22,300.00	
T. H. Soule, So. Freeport, Me.	10	22,945.00	
Badger Shipbuilding Co., Green Bay, Wis.	10	23,500.00	
New York Yacht, Launch & Engine Co., New York	10	23,600.00	30 days
U. S. Navy Yard, Mare Island, Calif.	10	23,611.00	
	15	23,177.00	
	17	23,093.00	
Rice Bros. Corp., East Boothbay, Maine	10	23,950.00	60 days
Ballard Marine Ry. Co., Seattle, Wash.	10	23,236.72	60 days
Southern Shipyard Corp., Newport News, Va.	10	24,000.00	
	15	23,750.00	30 days
Portsmouth Navy Yard, Portsmouth, N. H.	3	24,140.00	
A. W. DeYoung, Alameda, Calif.	15	24,320.00	90 days
Chance Marine Construction Co., Annapolis, Md.	10	24,250.00	60 days
Smith Dock Co., Leathem D., Sturgeon Bay, Wis.	10	24,400.00	
	15	24,000.00	20 days
Sturgeon Bay Dry Dock Co., Sturgeon Bay, Wis.	10	24,600.00	
	15	24,100.00	30 days
Kingston Dry Dock & Construction Co., Kingston, N. Y.	10	24,750.00	30 days
Vinyard Shipbuilding Co., Milford, Del.	10	24,770.00	
Matthews Co., The, Port Clinton, Ohio	10	24,985.00	
	15	24,497.00	
	25	23,945.00	30 days
Colonna's Shipyard, Inc., Norfolk, Va.	10 to 50	25,000.00	30 days
Luders Marine Construction Co., Stamford, Conn.	10	25,675.00	60 days
Smith & Williams, Salisbury, Md.	10	25,800.00	20 days
Burger Boat Co., Manitowoc, Wis.	10	26,000.00	
Moore Dry Dock Co., Oakland, Calif.	10	26,538.00	
	15	25,477.00	
	25	24,533.00	
	35	23,494.00	
	50	22,234.00	60 days
Virginia Yacht Building Corp., Portsmouth, Va.	10	26,575.00	
	15	26,280.00	30 days
Tebo Yacht Basin Co., New York, N. Y.	10	26,614.00	15 days
Gibbs Gas Engine Co., Jacksonville, Fla.	10	26,900.00	
	15	26,800.00	
	25	26,700.00	60 days
Newport News S. B. & D. D. Co., Newport News, Va.	10	27,000.00	30 days
Staten Island Shipbuilding Co., Staten Island, N. Y.	10	27,600.00	
	15	27,533.33	
Charleston Dry Dock & Mch. Co., Charleston, S. C.	10	27,631.00	30 days
U. S. Navy Yard, Norfolk, Va.	10	27,700.00	
	15	26,500.00	
	25	24,800.00	
	35	23,700.00	
	50	22,600.00	
Pacific Coast Eng. Co., Seattle, Wash.	10	28,242.00	
	15	27,909.00	
	25	27,642.00	30 days
M. M. Davis & Sons, Solomon's, Md.	10	28,668.16	10 days
C. Hiltebrant Dry Dock Co., Inc., Kingston, N. Y.	10	28,900.00	
	15	28,800.00	
	25	28,700.00	60 days
International S. B. & Marine Eng. Co., Nyack, N. Y.	10	29,280.00	30 days
Tregoning Boat Co., Seattle, Wash.	10	29,370.00	
	15	29,200.00	
	25	29,000.00	
	35	29,000.00	
	50	28,500.00	20 days
U. S. Navy Yard, Charleston, S. C.	10	29,400.00	
Welin Davit & Boat Corp., Long Island City, N. Y.	10	29,500.00	30 days
U. S. Navy Yard, Boston, Mass.	15	29,589.00	
American Car & Foundry Co., New York, N. Y.	10	29,700.00	
	15	29,000.00	
	25	28,500.00	
	35	28,000.00	
	50	27,500.00	30 days
G. W. Kneass, San Francisco, Calif.	10	29,843.35	
	15	29,843.35	
	25	29,843.35	
Ira S. Bushey & Sons, Inc., Brooklyn, N. Y.	10	31,000.00	
	15	30,800.00	20 days
Lawley & Son Corp., Geo., Neponset, Mass.	10	32,000.00	
	15	31,600.00	
	25	31,000.00	20 days
Greenport Basin & Construction Co., Greenport, N. Y.	5	32,000.00	30 days
Richard T. Green, Chelsea, Mass.	10	32,300.00	
Wheeler, Howard E., Brooklyn, N. Y.	10	32,845.00	30 days
Rochester Boat Works, Inc., Rochester, N. Y.	10	33,000.00	
	15	32,500.00	20 days
U. S. Navy Yard, New York, N. Y.	10	33,415.00	
	15	32,945.00	
	25	32,495.00	
U. S. Navy Yard, Puget Sound, Wash.	5	34,567.00	
Crowley Launch & Tugboat Co., San Francisco, Calif.	10	34,000.00	30 days
J. C. Johnson, Port Blakely, Wash.	10	35,000.00	
	15	32,500.00	
	25	30,000.00	5 days
Robert Jacob, City Island, N. Y.	10	35,175.00	30 days
Elco Works, Bayonne, N. J.	10	35,700.00	
	15	35,400.00	
	25	34,900.00	
	35	33,600.00	
	50	29,447.00	60 days
Pennsylvania Shipyards, Inc., Beaumont, Texas	15	37,500.00	30 days
Consolidated Shipbuilding Corp., Morris Heights, N. Y.	10	39,000.00	30 days

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ench Now Dictating Price of Steel in Europe

By Captain G. L. Carden

HE occasion for the present shipbuilding boom in France is attributed by M. Paul Tharlet, engineer-in-chief of French Sulzer Works, to the fact that ch steel works can now supply machin- plants and shipyards with practically all rements. This is one of the outcomes e war. The rate of exchange for the at the first of the year helped the tion but the main cause, M. Tharlet ves, is the enhanced contributing power e French steel plants. Competition, he ares, resolves itself largely into the tion of obtaining steel cheaply and lly. These two essentials are being ded in France today and constitute the keynote of French success in obtaining v foreign orders for building ships.

considering the favorable position of ch shipyards today it must be borne in l that many of the French steel plants directly interested in shipbuilding com- es. It is a well known fact that French interests have been the controlling or in the French parliament since the ination of the war, and that, as matters d today, the French are practically able lictate from Paris the price of steel on continent of Europe.

spections made by the writer during the two months among French manufactur- plants discloses that many works are t of high-grade machine-tools of the ium class, and in the French shipyards e has practically been little addition e the pre-war period. If the present n continues, the French yards must soon n the market for large additions to their ent machine tool installations.

esel Engines for French Vessels

DIESEL engines are entering largely into cargo and passenger vessel construction now in progress in French shipyards. h Burmeister & Wain and Sulzer designs being used. The French Navy has en up the Sulzer engine for submarine allations. At both the Loire and the zer shops in St. Denis, outside of Paris, 50 horsepower Sulzer Diesels are under struction for sub-surface vessels. These gines run at 350 revolutions, maximum, minute and yield a surface speed of 15 ts for the Requin type submarine. This maintained cruising speed. The com- ssor pumps are direct-connected to the in engine. Scavenging pumps are operated pendently. Electro-turbo blowers are d. These last insure a mechanical ciency of about 73 percent.

ontract Placed for Maneuver Boat Hulls and Derricks

The Charles Hegewald Company of New bany, Ind., has been awarded a contract the United States Engineer office, Louis- le, Kentucky, for the construction of five el hull maneuver boats. The same office s awarded the American Hoist & Derrick mpany of St. Paul, Minn., a contract for e steel derricks. The Hegewald Com- ny was low bidder for the boats at a price $52,790 and the American Hoist & Der- k Company was low bidder for the der- ks at $8,890, as result of tenders received April 28th.

French Naval Program Authorized; New Transatlantic Liner to Be Built

By Our Paris Correspondent

THE last few weeks have been marked by several developments of considerable importance as far as French shipping is concerned: they have been featured by the suppression of the Under Ministry for Mercantile Marine, and on the other hand by the voting by Parliament of several bills relative to the merchant marine which had been kept in abeyance for many months in view of the pressure on legislative work arising from the urgency of the adoption of certain measures intended to improve the financial outlook of this country.

Merchant Marine Absorbed by Department of Public Works

The suppression of all Under Ministries for the purpose of economy had been planned months ago, but it had been hoped that that for the merchant marine should escape from this drastic measure. When the ministerial crisis broke out on March 29, following a vote of non-confidence of the Chamber in the Poincare Cabinet, strong applications were made in order to obtain the maintenance of Mr. Rio at the head of the French merchant marine, in view of the excellent work accomplished by that Under Secretary of State during the last three years. But those efforts met with a firm opposition, and the Prime Minister decided that the department of mercantile marine should be absorbed by the Ministry for Public Works which has been kept in the hands of Mr. Le Trocquer: the latter has now the title of Minister for Public Works, Ports and Merchant Marine. That change in the control of the French shipping policy has been generally regretted in shipping circles as Mr. Rio, who has thus been forced to retire, finds himself unable to carry on his efforts towards the revival of French shipping.

It is noteworthy that under the skilful impulse of that Under Secretary of State, several favorable innovations have been introduced in the regulations pertaining to the merchant marine. The general feeling of disappointment has been somewhat allayed in the early days of April by Mr. Le Trocquer who has set forth that he would spare no effort to improve the conditions of the shipping trade and that he would devote particular attention to all questions connected with the merchant marine.

The most important items which have been dealt with by the Chamber of Deputies in the beginning of April prior to the dissolution which is to be followed by the general elections are: the final approval of the liquidation of the State merchant fleet, the introduction of a Disciplinary and Penal Code for the merchant marine, the authorization given to the Minister of Navy to place orders in 1924 for two 10,000-ton cruisers, six 1,450-ton torpedo-boats and two 1,500-ton submarines, and to purchase two 6,000-ton tankers, the adoption of the Strasburg port extension scheme, and the ratification of the agreement in respect of the operation of the Havre-New York service.

Construction of Warships and Transatlantic Lines Assured

The forthcoming orders for the new warships above referred to are the object of a great expectancy among shipbuilders, while a good deal of interest is being displayed in connection with the order which is to be placed by the Compagnie Generale Transatlantique for a new liner, as a result of the approval of the financial arrangements providing for the assistance given by the State to the company. It will be recalled that according to those arrangements the Government will guarantee the interest on the loans which are to be raised by the French Line for the construction of two new big liners to be placed in service on the mail line between Havre and New York.

The ratification of those arrangements by Parliament had been expected for months, and now that it is a "fait accompli," the company is at last in a position to place the order for the first of these liners, the construction of which will take about three years. Nothing has so far been ascertained as to the dimensions of that ship, although it is rumored that she will be of a somewhat enlarged *Paris* type. The same uncertainty applies to the choice of the type of propelling machinery. Considerable stir is being aroused among the leading shipbuilding concerns in connection with that forthcoming order.

It is learned on the other hand that the extensive work which has been carried out on the *France* at Saint-Nazaire by the Chantier et Ateliers de Saint-Nazaire-Penhoet, comprising the conversion of the ship to oil-burning and her general overhaul and re-conditioning, has been completed. The liner sailed from Havre on May 10 on her first voyage as an oil burner, and the Compagnie Generale Transatlantique will henceforth run the two luxurious liners *Paris* and *France* on the New York line: both vessels having a service speed of about 22.5 knots.

I alluded in my last month's article to the launch of the passenger steamer *Champollion*, built by the Societe Provencale de Constructions Navales, at La Ciotat, near Marseilles, to the account of the Messageries Maritimes. I am now in a position to give full particulars of that fine vessel: she has a length of 156.70 meters over all, a breadth of 19.17 meters and a depth of 13.80 meters. Passenger accommodations are provided for 2 "grand luxe," 2 de luxe, 6 "demi-luxe," 179 first class, 133 second class, 128 third class and 500 'tween deck passengers.

The cargo-holds will have a total capacity of 7,000 cubic meters. The cargo handling appliances will consist of six 3-ton electric cranes and three 5-ton derricks. The propelling machinery will comprise two triple expansion engines, steam being supplied by seven boilers of the Prudhon-Capus accelerated circulation type. The total power developed by the engines will be about 4,500 horsepower.

The *Champollion* will be placed in service on the Egypt line of the Messageries Maritimes.

"Metal Mike" on the Seven Seas

The Sperry gyro-pilot, known as "Metal Mike," has given such a good account of itself that an order has been placed for equipping the remainder of the Shipping Board passenger liners. Installations have also recently been made on the tanker *Harvester* of the Texas Company, the *Matsonia* of the Matson Line and several Diesel freighters building in England for service to the Far East and Australia.

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TRADE PUBLICATIONS

A SMALL WOOD PRESERVING PLANT for modern processes and preservatives using the Century air system is described in a circular issued by Grant B. Shipley, engineer, Century building, Pittsburgh, Pa.

BOLINDERS COMPANY, INC., 30 Church street, New York, is sending out an 8-page circular illustrating and describing the various types and sizes of Bolinder marine oil engines and giving a list of several hundred installations.

HEINE CROSS-DRUM BOILERS are illustrated and described in Bulletin Number 53 just issued by the Heine Boiler Company, St. Louis, Mo. The bulletin takes up the design, construction, circulation, furnace arrangement and method of cleaning the boilers.

"AN UNUSUAL HISTORY OF PETROLEUM" is the title of an unique book which is being mailed free upon request by the Tide Water Oil Sales Corporation, 11 Broadway, New York, to users of lubricating oils and greases. In this book a seasoning of pure fancy serves to present instructive facts in an entertaining way.

AIR PUMP PACKING.—"Gladiator" air pump packing, which is made from standard grades of fabric material is being advertised by a folder issued by the Pilot Packing Company, Inc., Peoples Gas Building, Chicago. This packing comes assembled in sets ready for application and requires no change in the standard air pump stuffing box.

ROTARY STEAM ENGINES.—Steam Power Units developed by Baker Motors, Inc., Erie, Pa., are described in a catalogue being sent out by this company. This unit consists of a rotary steam engine, steam generator and oil burner. The engine is of the confined type having no dead centers which has made possible the application of high pressure steam through the use of the Baker valve.

"HOW TO ORDER BRASS," just issued by the Chase Metal Works, Waterbury, Conn., tells the purchasing agent not versed in technical details how to order the brass that he wants and how to so specify it that he will get it. The book emphasizes the fact that brass is a metal of many uses and characteristics and that the most important thing for the user to decide is which of these is most important for his use and then to make his specifications and instructions very definite concerning this one quality. Attention is also called to the names and differences of tempers, to the description of tests, to instructions about sending samples and especially to the tables on the "Common Uses and Tempers of Wrought Copper Alloys."

BUSINESS NOTES

The Plymouth Cordage Company, North Plymouth, Mass., will celebrate its one hundredth anniversary on June 12.

The Federal Shipbuilding Company, Kearney, N. J., announces the change of its corporate name to the Federal Shipbuilding and Dry-Dock Company.

The Dock & Terminal Engineering Company has taken over the engineering business formerly conducted by the Cleveland Dock Engineering Company. They will have offices at 15 Park Row, New York, and 4614 Prospect Ave., Cleveland.

Increased business in the manufacture of switchboards is the reason given by the General Electric Company for the construction of a new building at their West Philadelphia plant, which will be occupied about July 15 by a force of 800 to 1,000 workers.

The Th. Goldschmidt Corporation, 15 William street, New York, have the exclusive selling and exploitation rights to the Star Contra-Propeller in this country, Canada and Mexico and are consequently the only ones authorized to make quotations, grant licenses, etc.

On April 28, Judge Thompson of the United States District Court, Eastern District of Pennsylvania, signed a decree dismissing the American Bronze Corporation, Berwyn, Pa., from the receivership under which the corporation has been operating since August 8, 1923. The business is now restored to its stockholders and corporate control, and all creditors will receive one hundred cents on the dollar.

The new Board of Directors includes: Philip E. Guckes, president Integrity Trust Company, Philadelphia; George M. Huey, president Denny Tag Company, West Chester, Pa.; Wm. F. Fischer, president Fischer Machine Company, Philadelphia; S. B. Rheam, president Central Boiler Tank and Plate Works, Pittsburgh, Pa.; E. G. Anderson, Berwyn, Pa. The officers are: E. G. Anderson, president; Wm. F. Fischer, vice-president; G. Willard Frame, treasurer; John C. Smith, secretary.

Franklin L. Groff and George W. Bent have consolidated their numerous sectional manufacturing interests in the Middle and South Atlantic States and in New England in a single organization known as the Groff-Bent Corporation, with headquarters and show rooms at 218 West 40th street, New York City. The organization includes the J. R. Bunting Bedding Co., Philadelphia; Mersereau Metal Bed Company, Jersey City; G. W. Bent Company, Boston, Lewiston and Providence; Gasau-Thompson, Brooklyn; Foster Bros. Manufacturing Company, Baltimore, and Continental Bedding Company, Boston. Any information regarding special equipment for ships will be taken care of in the future by Groff-Bent Corporation.

MARINE SOCIETIES

AMERICA

American Society of Naval Engineers
Navy Department, Washington, D. C.
Secretary-Treasurer—Commander Bryson Bruce, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

Society of Naval Architects and Marine Engineers
29 West 39th Street, New York
Secretary and Treasurer—Daniel H. Cox.

National Association of Engine and Boat Manufacturers
29 West 39th Street, New York City
Secretary—R. R. A. Hand.

United States Naval Institute
Naval Academy, Annapolis, Md.
Secretary and Treasurer—Commander H. K. Hewitt, U. S. N.

American Marine Association
15 Park Row, New York
President—Frank J. Shipman.

The New York Tow Boat Exchange
11 Moore St., New York.
Secretary—Irving G. Keller.

Port of New York Authority
11 Broadway, New York
Chairman—E. H. Outerbridge.
Secretary—William Leary.

National Association of Masters, Mates and Pilots
National Secretary—M. D. Tenniswood, [illegible] St., Camden, N. J.

American Society of Marine Design
Secretary—B. G. Barnes, 202 Kendrick [illegible] Quincy, Mass.

National Marine Engineers' Beneficial Association
Headquarters 311-315 Machinists Building, Washington, D. C.
Secretary-Treasurer—George A. Grubb.

Atlantic Coast Shipbuilders' Association
1600 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

Council of American Shipbuilders
30 Church St., New York
President—Homer L. Ferguson.
Secretary-Treasurer—Henry C. [illegible]

American Steamship Owners' Association
11 Broadway, New York
President—Alfred Gilbert Smith.
Vice-President and General Manager—Willard L. Marvin.

United States Ship Operators' Association
149 Broadway, New York
President—C. H. Potter.

National Merchant Marine Association
Munsey Bldg., Washington, D. C.
President—Hon. J. E. Ransdell.

The Maritime Association of the Port of New York
78 Broad St., New York City
President—Charles H. Potter.
Secretary—Walter F. Firth.

Lake Carriers' Association
President—Wm. Livingstone, Dime Bank Building, Detroit, Mich.
Secretary—George A. Marr, Rockefeller Building, Cleveland, O.

Neptune Association
21 Pearl St., New York City
Secretary-Treasurer—Captain John F. Mills

Ocean Association of Marine Engineers
15 Whitehall St., New York City
Secretary—Bert L. Todd.

CANADA

Grand Council N. A. of M. E. of Canada
Grand Secretary-Treasurer—Neil J. Morrison, Box 886, St. John, N. B.

GREAT BRITAIN

Institution of Naval Architects
Adelphi Terrace, London, W. C.

Institution of Engineers and Shipbuilders in Scotland
39 Elmbank Crescent, Glasgow.

Northeast Coast Institution of Engineers and Shipbuilders
Bolbec Hall, Westgate Road, Newcastle-on-Tyne

Institute of Marine Engineers, Incorporated
85/88 The Minories, London, E.

ITALY

Collegio Degli Ingegneri Navali e Meccanici in Italia

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